THE ROYAL SOCIETY OF CANADA

FIFTY YEARS RETROSPECT

ANNIVERSARY VOLUME
1882-1932

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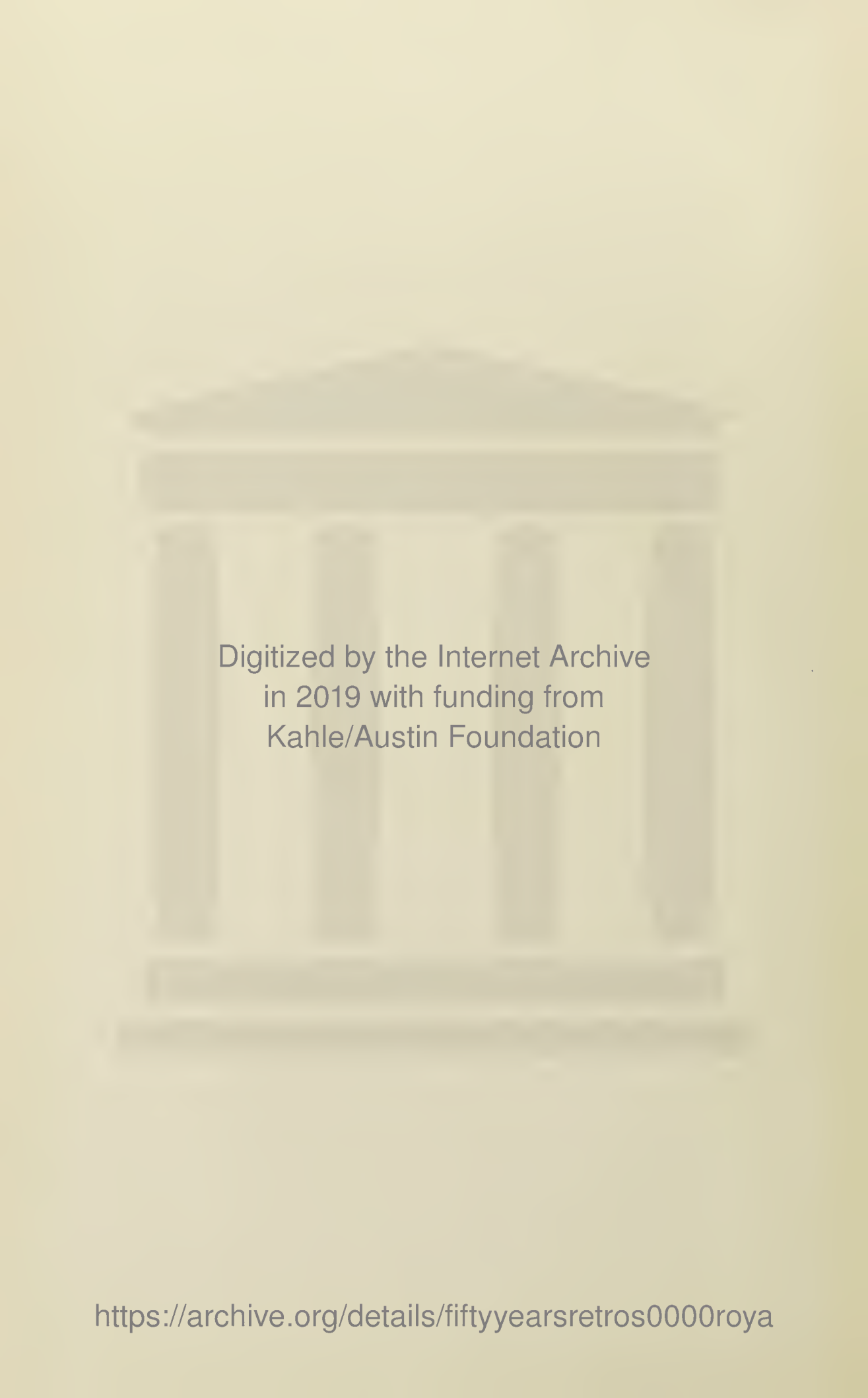
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LA SOCIÉTÉ ROYALE DU CANADA

RÉTROSPECTIVE DE CINQUANTE ANS

VOLUME ANNIVERSAIRE

1882-1932

THE ROYAL SOCIETY OF CANADA

FIFTY YEARS RETROSPECT

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PETERBOROUGH, ONTARIO

ANNIVERSARY VOLUME

1882-1932

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PREFACE

THE purpose of this book is to bring together, in permanent form, a series of papers prepared for the Fiftieth Anniversary of the establishment of the Royal Society of Canada. The Presidential Address may be regarded as the core, and around this have been built up surveys of progress in Canada, in the various subjects covered by the five Sections of the Royal Society, during its lifetime. The whole constitutes a striking proof of the dominating part taken by Fellows of the Royal Society in the intellectual and scientific life of the Dominion for half a century, and of the extent and value of the contributions made by the Society and its members to the welfare of their country.

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THE ROYAL SOCIETY OF CANADA

Founder: HIS GRACE THE DUKE OF ARGYLL, K.T., *etc.*
(WHEN GOVERNOR-GENERAL OF CANADA IN 1882)

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1929-1930.....A. T. Cameron, M.A., D.Sc.
1930-1931.....James Miller, M.D., D.Sc.
1931-1932.....J. B. Collip, Ph.D., D.Sc., M.D.

LIST OF AFFILIATED SOCIETIES

Ontario

Hamilton Association for the Promotion of Science, Literature and Art.
The Hamilton Scientific Society.
L'Institut canadien-français d'Ottawa.
The Women's Wentworth Historical Society.
The Entomological Society of Ontario.
Women's Canadian Historical Society of Ottawa.
Elgin Historical and Scientific Institute.
Women's Auxiliary of the Elgin Historical and Scientific Institute.
Ontario Historical Society.
The Huron Institute.
Niagara Historical Society.
The Ottawa Field Naturalists' Club.
Royal Astronomical Society of Canada.
Royal Canadian Institute, Toronto.
Historical Society of Kingston.
Lundy's Lane Historical Society.
United Empire Loyalists' Association of Canada.
Peterborough Historical Society.
Canadian Forestry Association.
Club littéraire canadien-français d'Ottawa.
Waterloo Historical Society.
Canadian Society of Technical Agriculturists, Ottawa.

Quebec

Société du Parler français au Canada, Québec.
Société de Géographie de Québec.
Société d'Economie sociale et politique de Québec.
The Quebec Society for the Protection of Plants from Insects and Fungus Diseases.
The Antiquarian and Numismatic Society of Montreal.
L'Association Technologique du Canada.
L'Institut canadien de Québec.
Natural History Society of Montreal.
Société historique de Montréal.
Cercle littéraire et musical de Montréal.
Literary and Historical Society, Quebec.

Alberta

Historical Society of Alberta, Edmonton.

British Columbia

The Natural History Society of British Columbia.
Academy of Science, Vancouver, B.C.
British Columbia Historical Association.

Nova Scotia

The Nova Scotia Historical Society.
The Nova Scotian Institute of Science.
The Historical Association of Annapolis Royal.
The Botanical Club of Canada.

Manitoba

Manitoba Historical and Scientific Societey.

New Brunswick

New Brunswick Historical Society.
New Brunswick Loyalists' Society
Miramichi Natural History Association.
Natural History Society of New Brunswick.

MEDALISTS

Flavelle Medal Awards

1925—C. E. Saunders, B.A., Ph.D.
1926—J. C. McLennan, Ph.D., D.Sc., F.R.S.
1927—A. G. Doughty, Litt..D., C.M.G.
1928—A. P. Coleman, M.A., Ph.D., F.R.S.
1929—A. H. R. Buller, D.Sc., Ph.D., LL.D.
1930—A. B. Macallum, Ph.D., F.R.S.
1931—F. B. Banting, M.D., D.Sc., LL.D., M.C.
1932—J. S. Plaskett, B.A., D.Sc., F.R.S.

Lorne Pierce Medal Awards

1926—C. G. D. Roberts, M.A.
1927—Duncan C. Scott, Litt.D.
1928—Bliss Carman, M.A., LL.D.
1929—Mgr. Camille Roy, Litt.D., Ph.D.
1930—Sir Andrew Macphail, B.A., M.D.
1931—Adjutor Rivard, M.A., Litt.D.
1932—Archibald MacMechan, B.A., Ph.D., LL.D.

Tyrrell Medal Awards

1928—Hon. Thomas Chapais, Litt.D.
1929—George M. Wrong, M.A.
1930—Adam Shortt, C.M.G., M.A., LL.D.
1931—Lawrence J. Burpee, F.R.G.S.
1932—Pierre Georges Roy, Litt.D.

LIST OF FELLOWS
OF THE ROYAL SOCIETY OF CANADA
1882-1932

Compiled by Lucien Brault, Public Archives of Canada

SECTION I

1919 Auclair, Elie-J.
1923 Audet, Francis-J.
1916 Barbeau, Marius.
1896 Beauchemin, Nérée.
1924 Beauchesne, Arthur.
1882 Begin, (Cardinal) Louis Nazaire.
1902 Bellemare, Raphaël.
1882 Bois, Louis Edouard.
1930 Bouchard, Georges.
1905 Bouchette, Errol.
1902 Bourassa, Gustave.
1882 Bourassa, Napoléon.
1905 Bruchési, Paul-N.
1921 Caron, Ivanhoe.
1882 Casgrain, Henri Raymond.
1902 Chapais, Thomas.
1899 Charland, Paul-Victor.
1916 Chartier, Emile.
1882 Chauveau, Pierre Joseph Olivier
1914 Choquette, Ernest.
1917 Chouinard, H. J. J. B.
1888 Cuoq, Jean André.
1890 David, Laurent Olivier.
1882 De Cazes, Paul.
1885 De Celles, Alfred Duclos.
1919 Delâge, Cyrille-F.
1918 Desprès, Azarie-Couillard.
1893 Dionne, Narcisse Eutrope.
1882 Dunn, Oscar.
1922 Emard, Joseph-Médard.
1882 Fabre, Hector.
1882 Faucher de Saint - Maurice, Narcisse Henri Edouard.
1918 Fauteux, Ægidius.
1928 Ferland, Albert.
1882 Fréchette, Louis.
1902 Gagnon, Ernest.
1915 Garneau, Hector.
1926 Geoffrion, L. P.
1898 Gérin, Léon.
1911 Gosselin, Amédée.
1892 Gosselin, Auguste.
1920 Gosselin, D.
1918 Groulx, Lionel.
1924 Lacasse, Arthur.
1926 Lanctôt, Gustave.
1908 Langelier, Sir François.
1882 Legendre, Napoléon.
1882 Lemay, Pamphile.
1928 Lemay, Hugolin.
1908 Lemieux, Rodolphe.
1882 Lemoine, Sir Jas. MacPherson.
1911 Lozeau, Albert.
1885 Lusignan, Alphonse.
1922 Magnan, C.-J.
1882 Marchand, Felix Gabriel.
1924 Marie-Victorin, Frère.
1882 Marmette, Joseph.
1920 Massicotte, E.-Z.
1931 Maurault, Olivier.
1908 Mignault, Pierre-Basile.
1913 Montigny, Louvigny de.
1914 Montpetit, Edouard.
1923 Morin, Paul.
1916 Morin, Victor.
1909 Myrand, Ernest.
1903 Paquet, L.-A.
1919 Pelletier, Georges.
1917 Perrault, Antonio.
1899 Poirier, Pascal.
1894 Poisson, Adolphe.
1903 Prud'homme, L.-A.
1896 Richard, Edouard.
1920 Rinfret, Fernand.
1908 Rivard, Adjutor.
1928 Ross, F.-X.
1915 Rouillard, Eugène.
1882 Routhier, Sir Adolphe Basile.
1904 Roy, Camille.
1891 Roy, Joseph-Edmond.
1911 Roy, Pierre-Georges.
1892 Royal, Joseph.

1926 Saint-Pierre, Arthur.
1917 Scott, H. A.
1923 Simard, Henri.
1882 Sulte, Benjamin.
1882 Tanguay, Cyprien.
1882 Tassé, Joseph.
1929 Vallée, Marie-Pierre-Arthur.
1882 Verreau, Hospice.

SECTION II

1892 Ashley, W. J.
1923 Ashton, Henry.
1928 Borden, Sir Robert Laird.
1882 Bourinot, Sir John George.
1919 Brett, George Sydney.
1901 Bryce, George.
1892 Brymner, Douglas.
1882 Bucke, Richard Maurice.
1911 Burpee, Lawrence Johnston.
1902 Burwash, Nathaniel.
1894 Campbell, Wilfred.
1917 Cappon, James.
1891 Clark, William.
1930 Clarke, George Herbert.
1923 Coats, Robert Hamilton.
1909 Colby, Charles W.
1906 Coyne, James H.
1906 Cruikshank, Ernest Alexander.
1917 Currelly, Charles Trick.
1929 Currie, Sir Arthur William.
1926 Dafoe, John W.
1882 Dawson, Æneas Macdonell.
1893 Dawson, Samuel Edward.
1882 Denison, George Taylor.
1887 Dent, John Charles.
1925 De Witt, N. W.
1905 Doughty, Arthur George.
1899 Drummond, William Henry.
1913 Eaton, Arthur Wentworth H.
1897 Edgar, Sir James David.
1915 Edgar, Pelham.
1916 Falconer, Sir Robert Alexander.
1927 Fay, Charles Ryle.
1922 Fox, William Sherwood.
1922 Gibbon, J. Murray.
1904 Gordon, Charles William.
1882 Grant, George Munro.
1911 Grant, William Lawson.
1889 Hale, Horatio.
1906 Hannay, James.
1894 Harvey, Arthur.
1928 Harvey, D.C.
1891 Harvey, Moses.
1919 Herrington, Walter S.
1913 Hili-Tout, Charles.
1917 Howay, Frederic William.
1902 Howley, M. F.
1913 Hutton, Maurice.
1905 James, Charles Canniff.
1929 Jenness, Diamond.
1910 Jones, Arthur Edward.
1910 King, William Lyon Mackenzie.
1890 Kingsford, William.
1882 Kirby, William.
1895 Lampman, Archibald.
1929 Landon, Frederick.
1913 Leacock, Stephen.
1882 Lesperance, John.
1903 LeSueur, William Dawson.
1902 Lighthall, William Douw.
1882 Lindsey, Charles.
1898 Longley, James Wilberforce.
1882 Lyall, W.
1894 MacCabe, J. A.
1921 MacIver, R. Morison.
1916 MacMechan, Archibald.
1917 MacNaughton, John.
1910 Macphail, Sir Andrew.
1889 Mair, Charles.
1920 Martin, Chester.
1914 Mavor, James.
1924 McArthur, Duncan.
1882 McColl, Evan.
1927 Magrath, Charles Alexander.
1911 McLachlan, R. Wallace.
1926 McLennan, John Stewart.
1899 McLennan, William.
1904 Morgan, Henry James.
1921 Morison, John Lyle.
1882 Murray, George.
1882 Murray, John Clark.
1918 Murray, Walter Charles.
1893 O'Brien, Cornelius.
1921 Oliver, Edmund Henry.
1898 Parkin, Sir George Robert.
1889 Patterson, George.
1914 Peterson, William.
1913 Phillips-Wolley, Clive.

1926 Pierce, Lorne.
1930 Pratt, Edwin John.
1906 Raymond, William Odber.
1882 Reade, John.
1917 Riddell, William Renwick.
1890 Roberts, Charles Geo. Douglas.
1896 Ross, Sir George William.
1925 Sandwell, Bernard Keble.
1882 Sangster, Charles.
1922 Sapir, Edward.
1894 Schultz, Sir John Christian.
1899 Scott, Duncan Campbell.
1900 Scott, Frederick George.
1906 Shortt, Adam.
1916 Skelton, Oscar Douglas.
1882 Smith, Goldwin.
1920 Stewart, Herbert Leslie.
1882 Stewart, George.
1930 Surveyor, Edouard Fabre.
1910 Thomson, Edward William.
1882 Todd, Alpheus.
1911 Walker, Sir Edmund.
1928 Wallace, W. Stewart.
1882 Watson, John.
1928 Waugh, William Templeton.
1924 Webster, John Clarence.
1923 Weir, Arthur Stanley.
1900 Willison, Sir John S.
1882 Wilson, Sir Daniel.
1884 Withrow, William Henry.
1905 Wood, William.
1908 Wrong, George Mackinnon.
1882 Young, George Plaxton.

SECTION III

1914 Allan, Francis Barclay.
1909 Allen, Frank.
1918 Archibald, Ebenezer Henry.
1929 Ardagh, E. G. R.
1882 Baillargé, Charles.
1915 Bain, James Watson.
1899 Baker, Alfred.
1902 Barnes, H. T.
1882 Bayne, Herbert A.
1925 Beatty, Samuel.
1930 Bigelow, H. E.
1921 Boswell, Maitland C.
1888 Bovey, H. J.
1921 Boyle, Robert William.
1916 Bronson, Howard Logan.
1921 Buchanan, Daniel.
1913 Burton, E. Franklin.
1895 Callendar, Hugh L.
1882 Carpmael, Charles H.
1923 Chant, Charles Augustus.
1882 Chapman, Edward J.
1882 Cherriman, J. B.
1915 Clark, A. L.
1928 Clark, Robert H.
1897 Cox, John.
1924 Dawes, Henry F.
1896 Dawson, W. Bell.
1893 de Foville, P.
1918 DeLury, Alfred Tennyson.
1882 Deville, E.
1928 Dines, Lloyd L.
1882 Dupuis, N. F.
1890 Ellis, W. H.
1910 Eve, Arthur Stewart.
1924 Ferguson, John B.
1909 Fields, John Charles.
1882 Fleming, Sir Sanford.
1882 Fortin, Pierre.
1929 Foster, John Stuart.
1925 Gilchrist, Lachlan.
1882 Girdwood, Gilbert P.
1882 Gisborne, Frederick Newton.
1902 Glashan, John C.
1890 Goodwin, William Lawton.
1922 Gray, J. A.
1882 Haanel, E.
1882 Hamel, Thomas E.
1908 Harkness, James.
1924 Harper, W. E.
1882 Harrington, Bernard J.
1929 Henderson, George H.
1911 Herdt, Louis A.
1931 Hibbert, Harold.
1882 Hoffman, Christian G.
1922 Hughes, A. Ll.
1882 Hunt, Thomas Sterry.
1882 Johnson, Alexander.
1914 Johnson, F. M. G.
1890 Keefer, Thomas C.
1911 Kenrick, Francis B.
1926 Keys, David A.
1915 King, Louis Verrot.

1908 King, William F.
1910 Klotz, Otto.
1930 Lang, Robert J.
1911 Lang, William R.
1882 Loudon, James.
1922 Maass, Otto.
1908 Mackenzie, A. Stanley.
1925 Martin, W. H.
1911 McClung, Robert K.
1882 McFarlane, Thomas.
1882 McGregor, J. G.
1909 McIntosh, Douglas.
1903 McLennan, John Cunningham.
1893 McLeod, C. H.
1927 McTaggart, H. A.
1899 Miller, W. Lash.
1901 Owens, R. B.
1919 Parker, Matthew A.
1918 Patterson, John.
1931 Pearce, Joseph A.
1910 Plaskett, J. S.
1926 Robertson, J. K.
1931 Rosebrugh, T. R.
1900 Rutherford, Sir Ernest (Lord).
1896 Ruttan, R. F.
1917 Satterly, John.
1923 Shaw, A. Norman.
1925 Shipley, J. W.
1899 Shutt, Frank T.
1928 Smith, Stanley.
1913 Stansfield, Alfred.
1926 Stewart, R. M.
1901 Stupart, Sir Frederick.
1917 Sullivan, Charles Thompson.
1926 Thorvaldson, T.
1918 Tingle, John B.
1909 Tory, Henry Marshall.
1901 Walker, J. Wallace.
1924 Whitby, G. S.
1894 Williamson, James.
1910 Wilson, Harold A.
1930 Wilson, Norman Richard.
1923 Young, Reynold K.

SECTION IV

1902 Adami, J. G.
1896 Adams, Frank D.
1925 Alcock, F. J.
1913 Alcock, Nathaniel Henry.
1922 Allan, John A.
1900 Ami, Henry M.
1882 Bailey, Loring W.
1920 Bancroft, Austin J.
1903 Barlow, A. E.
1882 Barnston, George.
1924 Bell, J. Mackintosh.
1882 Bell, Robert.
1925 Bell, W. A.
1910 Bensley, Benjamin A.
1892 Bethune, C. J. S.
1911 Brock, Reginald W.
1911 Brodie, T. G.
1923 Bruce, Everend Lester.
1909 Buller, A. H. Reginald.
1885 Burgess, T. J. W.
1923 Burrows, Alfred G.
1918 Camsell, Charles.
1900 Coleman, A. P.
1919 Collins, William H.
1923 Cooke, Harold Caswell.
1926 Denis, T. C.
1882 Dawson, George M.
1882 Dawson, Sir John William.
1915 Dresser, John A.
1913 Faribault, Eugène R.
1885 Fletcher, James.
1891 Fowler, James.
1916 Fraser, C. McLean.
1882 Gilpin, Edwin.
1882 Gilpin, J. Bernard.
1920 Graham, Richard P. D.
1882 Grant, Sir James A.
1894 Harrington, W. H.
1916 Harris, D. Fraser.
1910 Harrison, Francis C.
1894 Hay, G. U.
1913 Hewitt, C. Gordon.
1882 Honeyman, D.
1913 Huard, Victor A.
1916 Hunter, Andrew.
1917 Huntsman, Arch. Gowanlock.
1919 Johnston, Robert A. A.
1922 Johnston, W. A.
1882 Jones, J. M.
1920 Kindle, Edward M.
1920 Knight, C. W.
1882 Laflamme, J. C. K.

1901 Lambe, Lawrence M.
1882 Lawson, George.
1911 Leathes, John Beresford.
1918 Lewis, Francis John.
1916 Lloyd, Francis E.
1901 MacCallum, A. B.
1909 MacKenzie, J. J.
1882 Macoun, John.
1882 Matthew, George F.
1909 McBride, Ernest W.
1913 McConnell, Richard George.
1888 McKay, A. H.
1909 McMurrich, J. P.
1915 McPhedran, Alexander.
1911 Miller, Willett G.
1890 Mills, T. Wesley.
1913 Moore, Clarence L.
1924 Moore, E. S.
1882 Murray, Alexander.
1908 Nicholls, A. G.
1925 O'Neill, J. J.
1882 Osler, Sir William.
1915 Parks, William Arthur.
1885 Penhallow, D. P.
1900 Poole, H. S.
1902 Prince, Edward E.
1888 Provancher, Léon.
1914 Roddick, Thomas G.
1882 Saint-Cyr, D. N.
1882 Saunders, William.
1922 Schofield, S. J.
1882 Selwyn, A. R. C.
1894 Taylor, G. W.
1917 Thomson, Robert Boyd.
1910 Tyrrell, Joseph Burr.
1925 Uglow, W. L.
1909 Vincent, Swale.
1915 Walker, Edmund Murton.
1919 Walker, Thomas Leonard.
1921 Wallace, Robert C.
1918 Westbrook, Frank Fairchild.
1910 White, James.
1882 Whiteaves, J. F.
1923 Wilson, M. E.
1882 Wright, R. Ramsay.
1921 Young, George Albert.

SECTION V

(Created in 1918)

1930 Babkin, Boris P.
1931 Baker, M. B.
1926 Banting, Frederick Grant.
1931 Best, Charles Herbert.
1924 Boyd, William.
1928 Boyd, W. H.
1930 Cairnes, Clive Elmore.
1920 Cameron, A. T.
1919 Cameron, John.
1925 Clemens, W. A.
1931 Cockfield, William E.
1925 Collip, J. B.
1928 DeLury, Justin S.
1926 Dolmage, Victor.
1930 Dyer, W. S.
1920 Fitzgerald, J. G.
1929 Galloway, John Davidson.
1919 Geddes, Sir Auckland.
1922 Gibson, Arthur.
1931 Gussow, H. T.
1926 Hadwen, Seymour.
1930 Hanson, George.
1922 Harding, V. J.
1927 Henderson, V. E.
1929 Hume, George Sherwood.
1928 Klotz, Oskar.
1928 MacKay, B. R.
1924 Macklin, Charles C.
1919 Macleod, J. J. R.
1926 Malcolm, Wyatt.
1927 Marie-Victorin, Frère. (Transferred from Section I.)
1931 Masson, C. L. Pierre.
1921 McKibben, Paul Stilwell.
1927 McLearn, F. H.
1926 Meakins, J. C.
1922 Miller, F. R.
1922 Miller, James.
1930 Newton, Robert.
1922 O'Donoghue, Charles H.
1927 Poitevin, Eugène.
1927 Rose, Bruce.
1921 Saunders, Charles E.
1928 Scarth, George H.
1928 Swaine, James Malcolm.
1922 Tait, John.

1927 Tanton, Thomas L.
1929 Thomson, Joseph Ellis.
1921 Thompson, Walter P.
1931 Warren, P. S.
1930 Wasteneys, Hardolph.
1926 Williams, M. Y.

CORRESPONDING MEMBERS

1900 Argyll, the Duke of.
1902 Berthelot, Marcelin.
1885 Bonney, T. G.
1904 Brunetière, Fernand.
1894 Bryce, James (Lord).
1925 Carman, Bliss.
1894 Clarétie, Jules.
1925 d'Herelle, F.
1884 Doucet, Camille.
1903 Ganong, W. F.
1895 Gravier, Gabriel.
1914 Hanotaux, Gabriel.
1894 Hector, Sir James.
1900 Higginson, Thomas Wentworth
1927 Jeffrey, E. C.
1914 Lamy, Etienne.
1887 LeRoy, Alphonse.
1930 Lillie, Frank Rattray.
1914 Lorin, Henry.
1884 Lorne, the Marquis of (Duke of Argyll).
1892 Lorne, the Marquess of.
1924 Margerie, Ernest de.
1884 Marmier, Xavier.
1901 Metzler, W. H.
1903 Osborn, Henry Fairchild.
1908 Ostwald, Wilhelm.
1897 Parker, Sir Gilbert.
1884 Parkman, Francis.
1884 Rameau de Saint-Père, Edmé.
1912 Salone, Emile.
1894 Scudder, S. H.
1916 Siebert, W. H.
1909 Thomson, Sir Joseph J.
1924 Watts, W. W.
1915 White, Charles David.
1890 Winsor, Justin.

INTRODUCTION

By Lawrence J. Burpee, *Honorary Secretary*

FIFTY years ago the Royal Society of Canada held its first meeting, in the Railway Committee Room of the House of Commons at Ottawa. It was established largely because of the vision and enthusiasm of the then Governor-General, the Marquess of Lorne (afterwards Duke of Argyll), who realized the possibilities of usefulness of such an organization to a young country like Canada, and not least because of the fact that it might help to check the tendency of a pioneer community to put an overwhelming emphasis upon material things.

At the suggestion of His Excellency, a group of Canadians met in Montreal, in December, 1881, and prepared a provisional constitution, which with certain modifications was ratified the following May when the Society held its first meeting. Between that meeting in Montreal and the organization in Ottawa five months later, a great deal of hard work must have been done. Unfortunately we have no records of what took place, beyond the Report of the Provisional Council, and that does not reveal the magnitude of the task with which that devoted little group of Canadians was confronted. Dr. J. W. Dawson, in his Presidential Address at the first meeting of the Society, hints that the idea was regarded in some quarters as premature. One can readily imagine that many Canadians of fifty years ago not only looked upon the suggestion of creating the Royal Society as premature, but expressed their views in no uncertain terms. It is therefore only just that credit should be given, not only to Lord Lorne who conceived the idea, but also to Dr. Dawson and his associates on the Provisional Council whose enthusiasm and hard work made the thing possible.

The Provisional Council consisted of the following members:—J. W. Dawson, P. J. O. Chauveau, J. M. LeMoine, Faucher de Saint-Maurice, Daniel Wilson, Goldwin Smith, T. Sterry Hunt, Charles Carpmael, A. R. C. Selwyn, George Lawson, J. G. Bourinot. These were the Fathers of the Royal Society of Canada.

The Charter Members of the Society were, in addition to the members of the Provisional Council:—Abbé Bégin, Abbé Bois, Napoleon Bourassa, Abbé Casgrain, Paul de Cazes, Oscar Dunn, Hector Fabre, Louis H. Fréchette, Napoleon Legendre, Pamphile LeMay, F. G. Marchand, Joseph Marmette, A. B. Routhier, Benjamin Sulte, Abbé Tanguay, Joseph Tassé, Abbé Verreau, R. Maurice Bucke, Æneas McDonell Dawson, G. T. Denison, G. M. Grant, William Kirby, John Lesperance, Charles Lindsey, W. Lyall, George

Murray, J. Clark Murray, Evan McColl, John Reade, Charles Sangster, George Stewart, Alpheus Todd, J. Watson, G. Paxton Young, Charles Baillargé, Herbert A. Bayne, Edward J. Chapman, J. B. Cherriman, E. Deville, N. F. Dupuis, Sandford Fleming, Pierre Fortin, Gilbert P. Girdwood, F. W. Gisborne, E. Haanel, Thomas E. Hamel, Bernard J. Harrington, Christian G. Hoffman, Alexander Johnson, J. T. Loudon, Thomas Macfarlane, J. G. McGregor, Loring W. Bailey, George Barnston, Robert Bell, George M. Dawson, Edwin Gilpin, J. Bernard Gilpin, James A. Grant, J. M. Jones, J. C. K. Laflamme, George Lawson, J. Macoun, George F. Matthew, Alexander Murray, W. Osler, W. Saunders, D. N. Stoyr, J. F. Whiteaves, R. Ramsay Wright.

Some of these were men of mediocrity, but others had already earned an established position and in the years that were to follow were to add to their reputation. One need only think of what Sir William Dawson meant to McGill, Sir Daniel Wilson to Toronto and George M. Grant to Queen's, of what the Geological Survey owes to George Dawson, the Meteorological Service to Charles Carpmael and the Dominion Experimental Farms to Saunders, of Osler's achievements in medicine, Macoun's in botany and Sandford Fleming's in engineering, and of the contributions to Canadian literature of the poets Fréchette and LeMay, the historians Sulte and Verreau, and the novelists Kirby and Marmette, to realize that the Royal Society counted among its charter members a number of men of unusual ability and force of character. With such men behind it, one is not surprised that the pessimistic predictions of certain Canadians in 1882 remained unfulfilled and that the Royal Society, instead of coming to an untimely end, became firmly established as a national institution.

In opening the first meeting of the Society, Lord Lorne expressed the hope that it might be instrumental in promoting "the completion of the national collections which, already fairly representative in geology, may hereafter include archives, paintings, and objects illustrating ethnology and all branches of natural history." That hope has been amply fulfilled in the fifty years that have since gone by, by the establishment of the National Museum, the National Archives and the National Gallery, each with creditable collections in its own particular field. Nor are these the only means for advancing the intellectual life of Canada, or adding to the sum of human knowledge, which owe their foundation to a greater or less degree to the Royal Society. One need only mention the Biological Board, the Geographic Board, the National Research Council, the Astrophysical Observatory, the

system of National Parks, the Cabot and Champlain celebrations, as illustrations of the interest the Royal Society and its members have always taken in the advancement of science and literature.

Dr. Dawson, at the inaugural meeting, also had a good deal to say about the purposes of the Royal Society, and how it might be made of most service to its members and to the country. "I would place here first," he said, "the establishment of a bond of union between the scattered workers now widely separated in different parts of the Dominion." The isolation of Canadian men of science is not to-day anything like what it was fifty years ago, when Dr. Dawson could say: "Our men of science are so few and our country so extensive that it is difficult to find in any one place or within reasonable distance of each other, half a dozen active workers in science." Nevertheless, even though it meets but once a year, the Royal Society provides an invaluable opportunity of bringing together most of the outstanding men in each great branch of science. And what applies to the natural sciences applies also to history, literature, economics and archaeology and the men whose energies are devoted to the teaching or development of these subjects.

It is interesting to note that as early as 1883 the Dominion Government was so impressed with the value of the work of the Royal Society and the importance of its contributions to science and literature that it made an annual grant of $5,000 for publication of its transactions. That grant, increased in recent years to $8,000, has been continued for half a century. That it has been justified many times over is patent to any one who is familiar with the character of the material published in the fifty volumes of Transactions. Apart altogether from the incalculable value of these thousands of papers as contributions to human knowledge, many of them represent a very tangible value in dollars and cents—a value that in individual cases might run into many millions from a national point of view. As Dr. Dawson pointed out, "the most insignificant natural agencies sometimes attain to national importance. A locust, a midge, or a parasitic fungus, may suddenly reduce to naught the calculations of a finance minister." The discovery of a new way of treating iron ore, or a new fertilizer, a way of combating rust in wheat, a concrete that will withstand severe temperatures, these are the problems that Fellows of the Royal Society of Canada are investigating, and any one of them may be worth to the country a hundred times the sum of all the grants from the Dominion Government to the Society.

One other point in the first Presidential Address should be mentioned here, because the criticism it meets is still at times directed

against the Royal Society. "It would be a mistake," says Dr. Dawson, "to suppose that this Society should include all our literary and scientific men, or even all those of some local standing. It must consist of selected and representative men who have themselves done original work of at least Canadian celebrity. Beyond this it would have no resting-place short of that of a great popular assemblage whose members should be characterized rather by mere receptivity than by productiveness. In this sense it must be exclusive in its membership, but inclusive in that it offers its benefits to all." The Society took as its models the Royal Society of London and the French Academy, each strictly limited in membership, the former devoted to science and the latter to literature. At the time of its organization the Society consisted of four Sections each of twenty Fellows, or eighty in all. Since then a fifth Section has been added, and the number of Fellows has gradually increased until it is now about three times the original number. Those who must put everything to the test of statistics would, perhaps, argue that the membership of the Society has increased much faster than the growth of population. If we must apply a statistical test, a more reasonable comparison would be with the increase in the number of Canadians doing serious work in literature, history, or the sciences. It is beyond all question that for one man in 1882 who might be regarded as a reasonable candidate for Fellowship in the Royal Society, there are available a dozen to-day.

From time to time there have been men in the Society who have proposed that the limitation of membership be abandoned, and that the Royal Society be put on the same footing as the British Association for the Advancement of Science. That, one cannot help feeling, would be a most unfortunate move. It would, in fact, destroy the whole character of the Royal Society. There is no particular reason why there should not be in Canada, as there is in Great Britain and the United States, a general society for the advancement of science; but the function of such a body is not that of the Royal Society, nor can its membership be of the same character. Apart from other considerations, in such an extremely democratic country as Canada the only recognition, except academic distinctions, that can now be offered to a man who has achieved preeminence in science or literature is to elect him to the Royal Society.

Under its constitution the headquarters of the Society are in Ottawa, and most of its annual meetings have been held there. Its first meeting away from Ottawa was held in Montreal in 1891. Six years later the Society met in Halifax, to celebrate the four hundredth anniversary of the landing of John Cabot on the shores of what is now

Nova Scotia. In 1902 it met in Toronto; and two years later in St. John, N.B., to commemorate the landing of the United Empire Loyalists one hundred and twenty years before. In 1908 the Society met in Quebec on the occasion of the Champlain Tercentenary; in 1914 it paid a second visit to Montreal; a decade later it again visited Quebec; and in 1928 it met in Winnipeg. During the half-century, therefore, it has held forty-two meetings in Ottawa and eight elsewhere.

Some of the activities of the Society have already been mentioned. It has, in fact, always given its wholehearted support to any movement that came within the wide boundaries of its legitimate interests and was designed to further the public welfare. As long ago as 1887 it backed Sir William Dawson's plea for a scientific federation of the Empire. In conjunction with the British Association for the Advancement of Science it urged upon the Dominion Government at different times the importance of tidal observations, coast hydrographic surveys and an ethnological survey of Canada. Incidentally it was instrumental in bringing the British Association to Canada on more than one occasion, as well as various international scientific organizations. Lord Lansdowne drew particular attention to the work of the Royal Society for an ethnological survey in addressing the Society in 1885. The 1891 meeting in Montreal was marked by a movement, finally successful, to induce the Canadian and British governments to cooperate in determining exactly the longitude of Montreal by the exchange of telegraphic signals with Greenwich.

The Royal Society was instrumental in securing the preparation of the first large-scale map of the Dominion; the measurement of the 98th meridian in cooperation with the United States; the establishment of geodetic surveys. It took an active part in the movements for inter-imperial cables, time reckoning and the improvement of geological nomenclature; in the encouragement of Arctic expeditions and the establishment of scientific research stations in Northern Canada. It has repeatedly urged the creation of a National Library in Canada, pointing out that in that respect Canada still ranks with Abyssinia and Patagonia. It has made representations to the Dominion Government at various times against pollution of Canadian waterways by sewage, and as to the dangerous qualities of certain matches and illuminating gases; has urged the establishment of industrial art museums, and the preservation of our forests. It has advocated amendments to the Copyright Act that would bring it into harmony with the practice in other civilized countries; and many years ago warmly endorsed the movement for free public libraries.

At the suggestion of the Royal Society, the Canadian Parliament

placed in the corridor leading to the Library of Parliament a plate commemorating the first voyage across the Atlantic entirely by steam, by the Canadian boat, "Royal William," in 1833. The Society took an active part in the Cabot, Champlain and Parkman celebrations, and in the movements to erect memorials to David Thompson and other Canadian explorers, as well as to preserve historic sites and particularly the Plains of Abraham and Louisbourg. Conscious of the fact that the action of Parliament some years ago in forbidding those titles of honour formerly bestowed by the Sovereign had left no suitable means of recognizing conspicuous and unselfish service to the State, the Royal Society recommended the creation of a Canadian Order of Merit that would carry great honour but no title. Its recommendation, however, fell upon deaf ears. One thing, however, the Royal Society emphatically did not endorse, and that was the movement for what is known as simplified spelling. One may still read with amusement Professor Clark's indignant repudiation of the then scheme for distorting and dismembering the King's English, in his Presidential Address in 1900.

The Royal Society, while always willing to place the knowledge and experience of its members at the disposal of the Government, has maintained a consistently independent attitude. Shortly after its organization the Dominion gave it a grant of $5,000 towards the cost of publishing its papers. This amount was continued from year to year, and in 1913 was increased to $8,000. It was reduced during the war years, and again as part of the necessary national economy in 1932. The Society has always been grateful for this help, but at the same time has felt that it was giving more than a fair return to the country in making available in printed form the results of important researches in every branch of literature and science. Beyond this annual amount, ear-marked for printing, the Society owes nothing to the Dominion or any other government, and it is probably as well that that should be so. "The less you have to do," said Lord Lansdowne, when he addressed the Society as its Honorary President, "with official interference, however well intentioned, the better for you. The form of government in the world of letters is republican, and that literary community will prosper most which depends least on external guidance and official recognition."

Then as to the more internal affairs of the Society, in 1894 an Index was published to the 12 volumes of the first Series of Transactions, and in 1908 a very complete Index was published, in a separate volume, of the First and Second Series, prepared by Benjamin Sulte. It is much to be desired that this Index should now be brought down to 1932 so

as to provide a much-needed key to the 50 volumes of Transactions. In 1894, also, was published a Bibliography of Members of the Royal Society, compiled by Sir John Bourinot. Also there were published in 1904, 1905 and 1906 respectively, as supplementary volumes to the Transactions of those years, three very valuable bibliographies prepared by Dr. N. E. Dionne, *Inventaire chronologique des livres, brochures, journaux et revues publiés dans la province de Québec de 1764 à 1904*, *Inventaire chronologique des ouvrages publiés à l'étranger dans diverses langues sur la Nouvelle-France et sur la Province de Québec, depuis la découverte du Canada jusqu'à nos jours, 1534-1906*, and *Inventaire chronologique des livres, brochures, journaux et revues publiés en langue anglaise dans la Province de Québec, de 1764 à 1906*. In 1902 began the publication of bibliographies of Zoology, Botany, Entomology, Geology and Palaeontology, in the annual transactions of the then three Scientific Sections. Unfortunately, this excellent series of bibliographies was discontinued some years ago.

In 1895, the meeting of Section II was marked by a Poet's Evening, at which those present had the privilege of hearing Archibald Lampman, Charles Roberts, Wilfred Campbell, Bliss Carman, Pauline Johnson, Duncan Campbell Scott, Frederick George Scott, John Reade, and other poets of the day, read their own verse. This interesting experiment was repeated on one or two later occasions, and then, for some reason, was abandoned. An equally interesting feature of the proceedings of Section I was the presentation of Diplomas of Honour to those who had distinguished themselves in some branch of literature.

The Society's diploma dates from 1902, its form having been settled by a special committee the previous year, and turned into Latin by the learned professors of Laval the following year. As early as 1899 it had been proposed that the Society award gold medals for outstanding work in history. Nothing apparently came of it at that time, but in 1924 Sir Joseph Flavelle endowed a gold medal to be awarded annually for meritorious work in science or literature. Subsequently, Dr. Lorne Pierce gave a gold medal for outstanding achievements in imaginative literature; and Mr. J. B. Tyrrell endowed one for work in history. Since literature is taken care of by the Lorne Pierce medal, the Flavelle medal is now awarded for science only.

A feature of the annual meeting from the beginning has been the Presidential Address. As a rule the President of each Section delivers a special address, but the outstanding address of each meeting is that given by the President of the Society on the opening night. In many cases these have been devoted to a survey, from varying points

of view, of the progress of the Royal Society and what it has accomplished. Frequently, however, the Presidents have used the occasion to impress upon their fellow-members the importance of some specific subject which, in the opinion of the speaker, had special claims upon the attention of the Society. One recalls, among many others, the addresses of Sir John Bourinot on "Our Intellectual Strength and Weakness", of Sir James Lemoine on "Manuscript Sources of Canadian History", of T. C. Keefer on "Water Power", of Dr. Loudon on "Universities in relation to Research", of Louis Fréchette, "Reflexions sur notre Epoque", of William Saunders on "Agricultural Progress", of R. Ramsay Wright on "Progress of Biology", of W. F. King on "The Value of Science", of Frank D. Adams on "The National Domain", of Senator Chapais on "La Science et l'Art dans l'Histoire", of Dr. A. P. Coleman on "International Cooperation in Science", of J. W. Longley on "Canadian Poets of the Great War", and of A. H. R. Buller on "The Plants of Canada."

The "Popular Lecture" was instituted at the Montreal meeting in 1891, and has been maintained ever since, the speaker being sometimes a Fellow of the Society and sometimes a distinguished lecturer from outside. Among some of the subjects discussed at these popular lectures, to which the friends of the Society are invited, are Science in Schools, Forestry, Electricity, Insect Life, Antarctic Exploration, Circulation of the Atmosphere, Liquid Helium, War Inventions, Evolution of the Brain, Japan and Islands of the St. Lawrence.

In 1931, the Carnegie Corporation generously endowed a series of ten annual Fellowships, to be awarded by the Royal Society, of an individual value of $1,500. The endowment covers five years, and the first Fellowships have been awarded in 1932. The Fellowships Board received considerably over one hundred applications, and it was found that the average quality of the candidates was so high that it became very difficult to select the best ten. It is gratifying to know that such a large proportion of young Canadians is equipped to carry on advanced research.

The Intellectual Life of Canada as Reflected in its Royal Society

By Sir Robert Falconer, K.C.M.G., D.C.L., Oxon.

Fifty transforming years have left their mark upon the life of the Dominion of Canada since in 1882 the Royal Society held its inaugural meeting. For the most part these years had brought, until shortly before the war, moderate material returns, many difficult problems, and not a little disappointment to those who saw thousands of the country's choicest youth allured away by the sunshine of prosperity which was flooding our neighbours. Canadian national life was not started upon its career without great travail, nor tended in the days of its infancy without much anxiety. Its present healthfulness has been due to simple fare and watchful nurture. Robust we are also because of climate and environment. But geography has been a source of both strength and weakness. The widely scattered English-speaking people have not yet been able to promote their ideals in such rich and concentrated soil as would yield an abundant intellectual harvest, though French Canada, compactly domiciled in the valley of the St. Lawrence, and unified by origin, aspirations, and homeland, has produced a distinctive culture.

When the Royal Society received its charter in 1881, the Dominion of Canada as a Federation was only fourteen years of age. Throughout the country the year was cloudy and the weather in general very unfavourable. On the Atlantic coast, the native industry of the building of wooden ships, on which the life of the Maritime Provinces had been fed, was on the decline, and, sadly regarding their diminishing importance, they were chafing against the political system into which they had entered under constraint. In Ontario, agriculture had been suffering ever since the close of the American civil war. The farmer had not yet learned to renew the fertility of his soil; he had little ready money and sold his small surplus of butter and eggs, often in trade, to the country store. Manufacture was in the pioneer stage of providing for local conditions, and had not yet the faith to venture into markets beyond its home; indeed, "decayed industries" were as common as they were depressing. In the previous ten years, "little capital, lack of transportation to the areas of mineral deposits, absence of adequate geological investigation, and uncertainty in regard to markets, hampered industry".[1] In the Prairie Provinces, struggling but vigorously

[1]CHBE vi 611.

independent, wheat was still the substance of things hoped for, and ranching was awaiting both the railway and refrigeration. British Columbia, discontented in the fastnesses of unpenetrated mountains, was in a threatening mood. All were critical of Ontario, where Edward Blake was throwing cold water on the faith of financial and government leaders, as he continued to do until 1891, lamenting "an empty West, empty still." But these leaders were justified when through engineering skill, pluck and drive, the transcontinental railway was realised as an accomplished fact in 1885, antedating their promise by several years.

It was, therefore, a time when there was great need for unifying influences. The central parliament at Ottawa meant much, but less than would have been the case had provincial rights not loomed so large. The churches, which had been united into Dominion-wide bodies, were indeed a consolidating factor. But of unity of purpose in education there was hardly any. Being left to the provinces it went on as before in the older East, though the prairies paid silent but sincere homage to Ontario by adopting from it the only school system which most of the pioneers knew, and which was then being lauded in their old home as a wonderful creation.

The universities had no contact with one another. Most of them had been conceived, born, and nourished for sectarian purposes, and all were very poor. Because they were poor they were ill-nurtured, and were as a rule at odds with one another. Professors were badly paid, libraries were meagre, laboratories were few and scantily equipped, museums hardly existed. The provincial treasurers, harassed by other demands for which they were afraid to tax their constituents, took advantage of the divided interests of the colleges to refuse aid impartially to all.

The intellectual maturing of the Canadian people was thus delayed by the conditions of their life. They were, as we have seen, for the most part still in the pioneering stage, and had to devote their energies to the primitive tasks of making a living. But more than that the average settlers had come from districts in Britain and the United States, and from social classes, in which education was backward; very few from families which had the tradition of the English public schools and of Oxford and Cambridge, or of the Scottish and Irish universities. There was only a handful of educated people in small towns and cities,—lawyers, clergymen, doctors, officials; and these were few and far between, scattered from Halifax to Western Ontario. Both derivation and environment were unfavourable; there was neither intellectual tradition nor sympathy for

learning. So far neither the reading public nor the appreciative constituency was sufficiently large to make talent sure of encouragement.

When in 1854, J. W. Dawson, as Superintendent of Education, was seeking to create for Nova Scotia a school system, young Simon Newcomb, taking from the pioneer ancestry of his Nova Scotia home a massive sincerity and from his mother a powerful brain, escaped to the United States, as he says, from a "world of cold and darkness" into a "world of sweetness and light." But even there the condition of affairs which he found did not fully satisfy him, for "Natural science," he writes in 1878, "had been cultivated by us with great success, but we were backward in every branch of exact science: in pure mathematics we seemed hopelessly behind in the race." A few years later, William Osler, brought up in the hardships of a frontier rectory in Ontario, had happily met in Trinity College, Toronto, and later in McGill, congenial teachers who fostered his genius. These and others indicate that the English-speaking stock had great vitality, and possibly their privations stimulated their character; but much native ability was diverted into the average callings or even was drawn off to the more promising fields of the south.

The higher education was defective in facilities for the study of the sciences, just the subjects which would appeal to the youth of a new country calling them to explore it; coming ill-prepared from poor schools to the stereotyped curriculum of the universities, they found themselves outmatched by teachers who had enjoyed the advantage of a classical education in the homes of an old civilisation. There was, therefore, among the Canadian-born a certain inferiority complex. Accepting the leadership of those who had brought to these provinces the tradition of British culture, and recognising their great indebtedness to them, they aspired with diffidence to succeed them. But here and there "nativism" began to break out, especially when students were able to get access to, and hold their own in, the new laboratories of Johns Hopkins, and to frequent the lecture-rooms and libraries of Britain and Germany. From that time on Canada took charge of her own education, without, however, being ungrateful to those who had moulded her higher life, or ceasing to welcome from the old Land successors to them.

The Royal Society could not have come into existence when it did had there not been material out of which to construct it. There were, of course, the universities which sent their share of fellows; there was also in the new capital at Ottawa a nucleus of scientists who were being assembled to give advice to the government administration. This could be traced back as far as 1843, when Sir William Logan was

appointed first head of the Canadian Geological Survey, and began with distinction to explore, map and survey this vast country; a work which has been carried on with remarkable results under his capable successors. But other materials lay to hand in the scientific, historical and literary societies which functioned in the provincial capitals and urban centres. To mention only three: The Literary and Historical Society of Quebec established under Lord Dalhousie by royal charter in 1824, the Natural History Society of Montreal in 1829, and the Canadian Institute in Toronto in 1849, the last having as its object "the encouragement of learning and the development of science and the arts throughout the province." That these societies had in some measure prepared the ground for its creation was shown by the procedure of the Royal Society in affiliating them with itself and in receiving from them each year a report of their work. Lord Lorne, in his address at the initial meeting, emphasised the desire to "constitute it on such a basis that it might serve as a bond of union, and a means of friendly cooperation among all those engaged in the cultivation alike of letters and science throughout our Dominion"; and in 1886, Dr. Hamel made this prophecy: "Nous verrons bientôt ce réseau de travailleurs et de sociétés locales couvrir tout notre immense et magnifique pays—la noble contagion d'étude et de travail." In the local programmes occur frequently names which afterwards appear as those of fellows in the Proceedings and Transactions of the national Society.

Those who in 1881 initiated the Royal Society took a most important step towards the unification of the cultural life of the new Dominion. They were men of faith and vision. They were bold in assuming that the scattered provinces had in them educated persons who could maintain a Society to which such an honoured name might be worthily applied, the most famous in the annals of Britain's scientific history, and in serving themselves heirs to the practice and methods of the greatest Institute of France, which they adapted with much originality to suit their local conditions. The boldness was indicative of the founders' faith, especially that of one of Canada's most illustrious sons, John William Dawson. Also the memory of his Excellency, the Marquis of Lorne, deserves well of us, because he encouraged the idea and promoted its realisation. So far as I am aware, no other Commonwealth has a central Society of this kind. In both Australia and South Africa the unified scientific organisation has been conformed more to the British Association for the Advancement of Science, which is intended to appeal to a wider public.

Probably at the time the project was regarded as a dream of

enthusiasts. When the man-in-the-street was wondering how the country would get markets and carry its financial burdens, who would listen to little groups discussing abstract science or local history? The country was run by practical people to whom a professor was a strange being, and for whose upkeep they contributed hardly anything. Even recently when representatives of the Society have sought for financial support, the questions asked have shown that it is still regarded by some as a mutual admiration association of people who, as Earl Balfour said of the metaphysicians, "to the world at large seem to sit apart from their fellow men, seeking wisdom by methods hard of comprehension, and gently quarrelling with each other in an unknown tongue."

In his opening presidential address in 1882, Principal Dawson said: "We are sometimes told that the enterprise in which we are engaged is premature, that like some tender plant too early exposed to the frost of our Canadian spring it will be nipped and perish. But we must remember that in a country situated as this is, nearly everything is in some sense premature." This is one of his characteristically wise observations, and his wisdom and that of his contemporary fellows have been justified of their children, as may be abundantly shown in the record of Canadian intellectual accomplishment recorded in the forty-nine volumes of the Transactions of the Society.

If I mention a few of the names of the charter fellows it will be evident that Canada was not without distinguished leaders in science and letters. In addition to the president, John William Dawson, there was his hardly less eminent son, George Dawson; in Section I, there were Chauveau, Fréchette, Routhier, Sulte; in II, Principal Grant, Kirby, Clark Murray, Sangster, Goldwin Smith, Todd, Daniel Wilson, George Paxton Young; in III, Carpmael, Sandford Fleming, Sterry Hunt, Loudon, J. G. McGregor; in IV, Osler, Saunders, Selwyn. Of the founders only two are still alive, Ramsay Wright, who has for many years made his home in Oxford, and John Watson, who lives in retirement in Kingston.

Not the least interest offered by the Transactions is to observe the first appearance and the growing frequency, either in the affiliated societies or in the Royal, of the contributions of young men who were destined to come into prominence. In the first volume two papers presented by Professor Wright bear the name of J. Playfair McMurrich, followed soon by that of A. B. Macallum. In 1888, a distinguished father, William Saunders, seems to prepare for the work of his distinguished son, when he makes "Observations on Early Ripening Cereals," remarking that a young chemist, F. T. Shutt, was working

with such cereals from Russia, Northern Europe and the Himalyas, and venturing the hope that experimental farms might become an important aid in the settlement of distant parts of the Dominion, a hope magnificently fulfilled. Then in 1884, John Lesperance tells how a New Brunswick boy sent him a small copybook containing a number of short poems, one of which, "this flower of a sonnet," he had published in the Canadian Illustrated News. He adds, "Let the Royal Society send a word of greeting to Mr. Roberts and encourage him to go on cultivating a talent which must inevitably lead him to fame."

My primary purpose in this paper is to endeavour to trace, through the Transactions of the Society, the way in which many of the most distinguished workers in the intellectual field of Canada were stimulated by the new problems that originated in their *milieu*, and to show that, in attempting to solve them, as they did with much success, they made original contributions to human knowledge, and proved that the intellectual life of the country, though of small proportions and far-flung, was essentially of high quality. I shall not attempt what would be for me the absurd task of appraising the value of specific contributions. Those capable of doing so will outline the growth in Canada of the several branches of science and learning throughout our period in papers read before the sections. Mine is a much more superficial undertaking, to indicate a few landmarks or phases of the uplands that have been possessed by our intellectual explorers. For convenience sake I will begin with the scientific sections.

Most would agree, I suppose, that in the geological sciences Canada has from the earliest days right down to the present been in the forefront. Sir William Dawson claims that "Canada has naturally taken the lead in the discrimination and classification of the old pre-Cambrian rocks—well in advance of anything in Europe at that time"; and George Dawson, in 1894, states that "No region comparable in size to the Dominion has ever been so expeditiously and so accurately surveyed for purposes of settlement." Probably as a result of the influence of Sir William Dawson there was in McGill a strong school of geology, one member of which, Dr. Frank Adams, is happily still an active fellow of the Society. Men from New Brunswick also investigated their own areas, reporting regularly; and from Ontario three may be mentioned: A. P. Coleman, two of whose papers were "The Drift of Alberta and Keewatin Ice Sheets" and "Gaspé"; J. B. Tyrrell, who contributes gleanings from his explorations in the vast Northwest; and Willett Miller, prematurely cut off, "the discoverer of Cobalt," the first man in Canada to receive the gold medal from the London Institute of Mining and Metallurgy. Papers by others dealt

with the rich treasure-trove which has been secured from the graveyard of the dinosaurs on the banks of the Red Deer river. Right to the present, both in the universities and in the Survey, Canadian geological science dealing with its own problems has won and maintained a unique position.

In the kindred sciences the Canadian scene has provided numerous problems. Botany has run a close second to geology, as was evident in Professor Penhallow's review of its progress from 1800 to 1895. In 1887 he had remarked that the "Beginning of botanical work here was practically simultaneous with the origin of the science in Europe. . . . Kalm having lived here for three years, 1748 on. . . . And ever since the subject has met with favour among Canadians." Professor Buller, in his presidential address in 1928, calls attention to the discovery and publication by our distinguished colleague, Frère Marie-Victorin, of what is probably the oldest botanical paper ever written in North America, *l'Histoire des plantes de Canada*, by an unknown author about 1698. But Dr. Buller adds that in spite of excellent work done in Winnipeg, Saskatoon and elsewhere, "which has attracted the attention of botanists of the world," Canada lags behind in respect of a comprehensive flora of her own and has no botanical gardens. We laymen share Dr. Buller's regret in regard to the latter deficiency.

Agriculture should and does afford stimulus to science in Canada. It has had a large share in the story of our Canadian land. Far back (1884) on experimental farms the conditions of the soils and climates of Canada in respect of cereals and fruits were studied, as well as the best means of counteracting rust, smut and mould; and chemical, botanical and entomological research was requisitioned, though in 1917 Dr. Shutt voices the need for better trained and more analysts. The magnetic observatory, taken over in 1853 from Great Britain, developed into the Meteorological Service of Canada and of late has come to the aid of the farmer on the prairie. Science has taught him not only what seed to sow, but is now telling him when to sow it, and how to lay his plans against possible ravages of the locusts. Unlike the Preacher of ancient days, the meteorologist does not say: "He that observeth the wind shall not sow; and he that regardeth the clouds shall not reap"; the farmer is assured, "Thou mayest know what is the way of the wind." Only second in importance to agriculture are the forests of the Dominion. The Society was alive to this fact, and again and again its agriculturalists, botanists and entomologists deal with their enemies whether pests or careless humanity, and warn against indifference.

Except on the south, Canada is washed by the ocean, and its inland

seas, lakes and rivers are unequalled in the world. For food supply, navigation and water power it has varied and almost illimitable resources. The first was so abundant that many years passed by until it became apparent to a few far-seeing scientists that the fisheries, if left unprotected, would in time suffer depletion; therefore, under the department of Marine and Fisheries, a hydrographic survey of the Great Lakes, was undertaken and an investigation of tides and currents of the St. Lawrence and the coastal waters; also studies were initiated in respect to the propagation of fishes. Year by year the survey of tides and currents proceeded and its bearing upon both navigation and fisheries became more obvious. A marine biological station, the inception of which had been urged by the Society, was completed in June, 1899, and many of the chief biologists of the Dominion began to work in it. The solution of the zoological problems relating to the fisheries was seen to depend upon organisation, equipment and special training; so under the Biological Board younger men have been set to work: to mention only one, Dr. Huntsman has urned to great potential use his studies on the growth of fishes and the effect of tide on their distribution on the Atlantic coast.

In 1901, the Society commended to public patronage the equipment of an expedition under Captain Bernier to explore "hyperborean hemispheres and discovery of the north pole." It also urged on the government the opening up of the great northland, a vast region which only a few men of science, explorers and trappers had entered, but so rich in waterpowers and in promise of minerals that its resources should be safeguarded, and it recommended that a beginning be made by the establishment of research stations and wireless telegraphy.

Two of the insistent facts in Canadian life are the boundary of the United States and inland transportation, the latter greatly contingent upon the former. During the life of the Royal Society several of the most difficult questions in the determination of the boundaries have been settled. The most important geographical and historical papers dealing with these are to be found in Section II, especially those by Professor Ganong and the late James White, discussions which are marked not less by their knowledge than by their discrimination. But geodetic surveys also had direct application to the international boundary problems. Sir Sandford Fleming, a distinguished engineer with an original and scientific mind, was always influential in the Society, and therefore while he lived transportation could not drop out of sight. Among his many original suggestions was that for the adoption of standard time on Greenwich mean time as its basis, the outcome of his experience in building the transcontinental railway.

His argument and resolution may be read in the annals of the Society.

Though medicine was represented in the Society from the beginning, —by Osler of McGill, Dr. Bucke of London, and Dr. Grant of Ottawa, it is in its more scientific aspects of anatomy, physiology and pathology that it has always been rightfully regarded here. In the last decade insulin, its discovery and development, has left its mark in the Transactions of the Society, as well as other important investigations in the pre-medical field by young men whose best work seems to be still ahead of them.

The scientific sections are thus a rich storehouse from which may be drawn material old and new to illustrate our scientific progress as it was stimulated by the problems presented for solution in the material expansion of the Dominion. Nearly all this scientific endeavour, directed to the practical issues of national problems, has been the result more of organised effort than of original initiative. But in making this effort Canada has been contributing an important share to the progress of mankind. The genius of her people consists in a high endowment of common sense which grasps the vital elements of a situation, and uses knowledge to separate them from the non-essential in order that upon those attention may be focussed. This has led to many advances in knowledge which have been welcomed by the world at large. At the stage in Canada's material and social equipment which we have under review, and in her widespread domain, science had to progress through organised bodies such as universities or departments subsidised by governments where only modest resources were available. Our scientists, indeed, have been expected to build bricks with very little and very poor straw. Voice has been given by the Society decade after decade for the creation of a national museum and a national library. Neither our men of science nor our men of learning can do their best until national consciousness and pride awake to the fact that the Dominion will not take her place intellectually among the leading peoples of the civilised world, until she provides a great library and great museums, and until there are adequate botanical gardens in provincial centres. The fact that so much has been done with such poor equipment is proof that our leaders have been both keen and industrious. For the most part science advances through the co-operative contributions of a multitude, and we rouse ourselves not infrequently to discover that she is much further along the road than we had imagined; many whose names were known only to their own circle having given her car direction and impetus on its way, without the sound of any commanding voice which caught the attention of the public. Merz says of England that she

has been richer in individual genius than in organised effort towards scientific research. "English societies may sometimes honour and admire, but they do not support, their great representatives, and these themselves often refuse to be tied by exclusive academic duties, still more by official restrictions. Two characteristics have marked most of them: they have, at all expense and sacrifice, guarded their individual freedom of thought, and they have almost always shown a great desire to combine some application with their abstract researches, to take part in the great practical work of the nation."[2] If the English characteristic of independent and original research has not been abundant in Canada, this is due in part at least to lack both of background and opportunity; but in respect of "taking part in the great practical work of the nation," the record of the Royal Society shows that its scientific fellows are sons of the blood. In outlining the rise of learned societies in Europe, Professor J. L. Myres emphasises "the desperate isolation of the pioneer in 'natural knowledge'." What he adds is pertinent to the conditions existing in Canada when the Royal Society was founded, "Three things were needed: opportunities for intercourse and conference among men of good will, good eyes and good sense; means for circulating, as well as compiling, the voluminous records of research, to preclude all but the most necessary duplication of experiences; and storehouses, perhaps even lumber-rooms, where the *curiosa naturae*, 'curiosities' or 'rarities' which defied explanation now, might be kept at hand till the crucial instance or happy conjecture came."[3] Even then "benevolent despotism naturally paid learning the dangerous compliment of conceiving that it might also be profitable." In Canada, however, we have suffered too little from any largesse, despotic or otherwise, to have been demoralised by profits.

It was in line with its aim and purpose that the Royal Society should encourage the application of science to all sides of the national life. In Britain the war had called into being a National Research Council, and in 1915 the Society recognises with satisfaction that an Honorary Advisory Council for scientific and industrial research has been established in Canada. Those who promoted its establishment and the successive chairmen of the Council, as well as most of its members, have been prominent fellows of the society. Supported by Dominion funds the Council has carried out investigations of industrial problems, and with wise foresight has provided scholarships and bursaries for training research students; in all of which it has the warm

[2]*European Thought*, I, p. 251.
[3]*Learned Societies*, p. 18,

approval and backing of the Society, and thereby the good-will of the most distinguished body of science and learning in the Dominion.

On turning to the less concrete sciences such as mathematics, physics and chemistry, it is to be observed that Sir William Dawson in 1885 remarked that, apart from the work of Dr. Sterry Hunt, he could not report progress in the physical and chemical sciences to equal that in the natural sciences. Simon Newcomb, as quoted above, makes a similar comment upon the condition in the United States. Confirmation of this has been given me by one of our outstanding mathematicians, who forty years ago had to go from Johns Hopkins to Germany and France for satisfactory advanced work. But Newcomb, writing in 1903, asserts that during the preceding twenty years there had been in America a wonderful development in mathematical and astronomical research. To judge by the personnel of the Royal Society and of the universities, it may be safely affirmed that in Canada a similar development has taken place in the last quarter of a century. Men, now of world-wide standing in their branches of science, have again and again reported their work and submitted papers to Section III.

Lest I should go beyond my depth and find myself in trouble, I will allow you, as I may surely do with safety, to draw a general conclusion as to the quality of the Society in the latter half of its career, by reminding you of the number of fellows who in this period have been fellows of the parent Royal Society. There have been Adami, Adams, Barnes, Brodie, Buller, Coleman, Eve, Fields, King, Leathes, Macallum, McBride, McGregor, McLennan, McLeod, Miller, Plaskett, Rutherford, Willey. Others there are who in the judgment of their Canadian colleagues are quite worthy to stand beside these, and we have perennial indication of our potential intellectual riches in the contributions that are being constantly made by our younger men. Every departing generation pathetically muses with itself on the impossibility of maintaining the standards that it has established, forgetting withal that it inherited many of these. Possibly our founders, as they withdrew from the scene, gave way to this very human pensiveness, but those who took their places have proved equal to their task, and I have no doubt that our older scientists may gracefully retire when their time comes, in the assurance that already younger men are picking up their torches and are running very fast with them.

Another testimony to the reputation of Canadian science has been afforded by the willingness of the British Association for the Advancement of Science, and its American counterpart, and other societies such as the Geological Congress in 1913 and the Mathematical Con-

gress in 1924, to hold regular meetings in Canada. When in 1884 the first of these, on the invitation of our Royal Society, held its first overseas meeting in Montreal, Sir William Dawson welcomed its coming as "a tribute to the intellect, culture, and scientific attainment of Canada, and her aspiration to take her place among the nations." Repeated visits from this and other learned and scientific bodies are pleasing evidence that Canada received her place in the universal fellowship of science earlier than, and quite as securely as, her seat among the nations of the world at the League of Nations.

In Canada the Royal Society performs a noble function in bearing witness to the disinterested pursuit of science. Placed as we are with a comparatively weak inheritance of culture in the midst of an unusually rich and still partially unexplored material environment, we are exposed more than most to the prevalent temptation of a commercial and industrial age to evaluate science in terms of the wealth that it can produce. We have to go as suppliants to governments or to the rich for help to carry on our researches, and we try to make our appeal persuasive on the strength of the cash values of the results. Accordingly, "research" has become a blessed word on the lips even of the profane, and may move great audiences of the uninitiated if pronounced with tone and unction. Far be it from me to alienate worthy allies from university or laboratory, but these must remain the homes and hearths of the incorruptible pursuit of knowledge for its own sake, and the Royal Society is the rallying place whither its crusaders and stewards forgather for mutual enlightenment and comfort.

Turning now to Section I, we have in its transactions perhaps the richest and most varied materials to be found anywhere in such convenient compass for the study of the intellectual ideals and the spiritual culture of the French-speaking Canadian people. It far surpasses Section II in respect of poetry and belles lettres, and embodies an aim similar to that of the French Academy in seeking to standardise and purify its own language. The fellows take pride in the fact that, as Chauveau said in the opening words of his vice-presidential address: "Il y a longtemps, bien longtemps que l'on fait de nobles efforts pour la culture de l'ésprit humain, sur les rives du Saint Laurent." Poems long and short by Fréchette, May and others less known are found, and studies on French literature in Canada, of which none are superior to those by our former president, Mgr Camille Roy. Of French-Canadian poetry, will you allow me to quote an appreciation by John Lesperance in the proceedings of Section II in 1884: "All the elements have been touched upon in their poetry—their history, enlivened by romance and consecrated by affliction;

their nationality, maintained in spite of all the disintegrating influences of conquest; their religion, homely and primitive as in the Brittany and Normandy of the Middle Ages; their social life, adorned by courtesy, inspirited by cheerfulness and stamped with a simple, old-fashioned sense of honour."

There are frequent essays upon the language, which it is claimed originated in the very cradle of old France—Poitou, the valley of the Loire, and Normandy. The study is taken up in 1908 by one of our recent Lorne Pierce medallists, Judge Adjutor Rivard, who champions La Société du parler Français au Canada. As late as 1928, M. L. P. Geoffrion claims that habitans speak not a patois, but "français commun, mais populaire". The names of some of the papers are suggestive: "La noblesse au Canada devant le 17me Siècle"; "Le Gentilhomme français et la colonisation de Canada". Benjamin Sulte, by his prolific pen, and others trace the origins of national symbols, festivals and practices, and plead for the conservation of disappearing popular beliefs and social types. "Le folklore Canadien français" is entertainingly discussed by our brilliant young colleague, C. Marius Barbeau.

Again and again the aim of French-Canadian culture and its aspiration are set forth. Poirier, in 1905, writes: "Comme français, commes catholiques notre place est parmi les latins. Notre mission évidente sur ce continent est d'y répandre les arts, la haute culture intellectuelle, la civilisation, l'âme splendide de la France-la foudation d'une France nouvelle en Amérique"; in 1908, Adjutor Rivard thus: "Soyons au point de vue littéraire, une province, mais une province intellectuelle de France"; and in 1919 Fernand Rinfret: "La France peut et doit rester notre inspiratrice dans la domaine de l'intellectualité. . . . Continuons d'être, par dela les mers, la sentinelle éveillée et joyeuse de la pensée française en Amérique". In 1926, Canon Chartier, in an important paper on "Le récent mouvement des idées au Canada français", outlines the contributions made to Quebec culture by professors from the universities of Lille, Lyons and the Sorbonne, and the postgraduate success of Canadian students in these centres, and remarks: "Notre langue et notre littérature sont les deux organes par lesquels nous temoignons à la France le souvenir que nous avons gardé de nos origines et notre fidelité à ses traditions".

This people in the valley of the St. Lawrence exults in its historic past, so full of suffering, heroism and faith, and of contentment with its own home. The boundary of the pioneer has withdrawn over the nearer hills into the Laurentians. A long settled countryside with towns and large cities, enjoying the privileges of economic comfort,

has produced for itself a native culture of song, story, poetry, heroisms history, and of the simpler arts, painting and sculpture; but in addition in the Royal Society we see the effort of its intellectuals to recognize in Old France the primary moulds in which this culture took shape, and to claim with confidence and develope in New France affinity with the mother far away, at whose knee it learned a tongue which, in the only home that it has ever consciously known, it does not in manhood forget.

Section II is the most composite of all. From the beginning its aims were vague. In 1884, Sir William Dawson eloquently writes: "Science, which is the interpreter of nature, must be the friend and ally of literature. Especially is this the case in a country whose history has depended more on the great natural features of the land itself than on the men who have come and gone; and where our real poetry is that of our great rivers, our vast lakes, our boundless plains, our forest solitudes and our changeful climate—unwritten poems which have impressed themselves on the minds and hearts of our people more than anything man has yet said or sung . . . for this reason I rejoice that our society embraces both science and letters." Rather nebulous this for a man of science, and probably Dawson had not seriously asked himself whether he could expect Section II to furnish the society with poetic ideality as a drapery for the realism of Sections III and IV. At any rate it has not done so. Another president, Principal Grant, spoke in 1891 like an *enfant terrible*, when he declared that "From its birth Section II has been in a condition of anaemia." This was certainly an overstatement. Except for a few contribution by two or three of our national poets, Section II has indeed not produced much pure literature, but it has registered the discovery of man's origins as well as his history from the earliest recorded days in our great lone land. Here, too, we observe, as in other sections, that our investigators have found rich local strands with which to weave the several patterns of our composite history. From the beginning archaeology has been important, together with ethnology and the philology of the Indian languages. Even if some papers may have been amateurish, there have been right down to the present contributions from authorities of the first rank. Of one, Horatio Hale, who died in 1896 after having pursued a rather unfrequented path, his biographer, Frank Boas, wrote, that he "contributed more to our knowledge of the human races than perhaps any other single student; his classification and investigations [into the difficult languages of North America] have stood the test of all later enquiries." Since then the subject of ethnology has been enriched by the work of eminent

scholars who in their line rank with those in Sections III, IV and V. Not a few of those who had first worked on local history in their home societies have contributed important papers to this Section, which for many years was the chief source for historical publication in Canada. Of late by natural growth history has expanded into a society of its own, as the economic sciences also are doing. The Champlain Society has performed a service which the Royal Society could not have undertaken. But for long this Section did a necessary work, by voicing the need that provision be made for the accumulation and care of the materials of our history, such as has been so splendidly carried out in the Archives.

Canadian geography receives a good share of attention in these Transactions. Combined with the treatment of leading historical events are investigations of the stage on which they were enacted. It was due to the Society that the Cabot celebration took place, and at the same time there appeared many learned discussions on his landfall. No province has had its geographical features more thoroughly examined in relation to history than New Brunswick, and by no one so completely as by her distinguished son, Professor Ganong. Exploration has offered an obvious and fascinating theme to several of our historians, providing them with material for both research and story. The fur trade, transportation development and the banking system of Canada have been dealt with by our own economists. Here I may recall the name of the lamented Adam Shortt, who played a large part both in the interpretation of the political and economic history of the country and in the conduct of its affairs.

Reflected in the Section also were the celebrations in 1908 of the founding of Quebec and of its capture. From 1915 to 1919 the war brooded over all. Its economic effect on Canada was dealt with by Dr. Adam Shortt, and by Dr. C. C. James in a paper on "An historical war crop of wheat." Notes by Professor Bronson, of both historic and scientific value, on the Halifax explosion, remind us how disastrously the war touched that community. Then Dr. Lighthall revealed "the agony of the bitter struggle" in a selection of war poems by Canadians. Alas, the comfort that he tried to offer us out of hope for a better future did not last, and the whole world is paying grievously in shattered beliefs,economic disaster,embittered peoples; while perhaps some of those of whom we dreamed as our coming leaders on the horizon of a nobler humanity lie asleep in Flanders or beneath the sea.

In the last decade the Section has been broadened by more frequent papers from Canadian scholars on criticism both of classical and modern literatures, and on philosophical subjects. The call for

independent devotion by Canadians to universal literature was made by Dr. D. C. Scott in his presidential address in 1922. He observes a change for the better in our outlook: "The environment in which Lampman lived was dull, and there was no feeling of nationality, a strong aid and incitement to a poet"; and he finds evidence for the progress of Canadian literature in the growing independence of our literary judgment as to our own poets, which has been generally accepted by the outside world. Now "we have faith in the power of our writers."

The appeal of Dr. Scott to judge our writers by the standards of world literature was timely. In science the Royal Society must abide by universal criticism as to the value of its publications: in letters, philosophy and history it must do likewise. To this end I would suggest that either the membership of Section II be enlarged, or that it be divided into two parts, in order that its original purpose may be more fully realised by the addition of more of our younger scholars in these departments. In fact, my suggestion is that Section II should be expanded in order to correspond more closely to the British Academy. Let me outline to you the origin and character of this comparatively late arrival in the fellowship of learning.

At a meeting of representatives of the chief European and American academies held in Wiesbaden in 1899 to organise an international association of the principal scientific and literary academies of the world, it was found that there was no institution in the United Kingdom competent to represent historical, philosophical and philological studies. Hence the Royal Society initiated a movement which led to the establishment of the British Academy in 1902. It was hailed as linking Great Britain in international cooperation with the republic of learning. The Academy is divided into four main sections: I, History and Archaeology; II, Philology in its various departments; III, Philosophy; IV, Jurisprudence and Economics. Annual lectures have been founded to be delivered by experts on History, Philosophy, Shakespeare, English Poetry, Italian Literature, Biblical Archaeology, Aspects of Art and "A Master Mind". The Academy co-operates both nationally and internationally with learned societies in the publication of rare books and in the compiling of lexicons and encyclopaedias and in other undertakings. Fellowship in this Academy is as great an honour for the humanist as is fellowhip in the Royal Society for the scientist.

Already in Section II we are doing admirably some of the work of a national academy; and if our fellows had not done it, much of the detail of our history would have still been buried in oblivion. What I

believe is called for in our Section is fuller treatment of the universal themes of literature and philosophy, the pursuit of which would give us a place in any international assembly of learned academies. Several of our fellows have been engaged in international excavations and the recovery of the records of the past outside Canada. Some one may say that we should stick to our job and do our own work in Canada. This, of course, we should do, but why leave the other to the United States and Europe? Canada is no longer where she was when our Royal Society was founded. Midway we have been placed between the civilisations of Europe and the Orient; and since the war we have become members of a wider world politically and economically. If we are to be a really cultured people we must take our share in pondering the universal problems of civilisation and human thought. In our universities we claim membership in the commonwealth of learning. Let the Royal Society also fulfil its function as an Academy. Every year in the world of scholars the anniversary of some great figure is commemorated: 1930 was the two thousandth anniversary of the birth of Virgil; this year the centenary of the death of Goethe and of Scott brings these men of genius to mind. Out of the past in close succession arise the names of those whose spirit has contributed powerfully to our present. If annually we were to choose an eminent Canadian to deliver a lecture to the Society on the "Master Mind" whom other academies of the world might be bringing before their members, we should take our place in the universal fellowship of letters and philosophy, and thereby also confer honour upon a Canadian scholar. I suggest, therefore, that we call into our fellowship more of the promising humanistic students of our country, many of whom are destined to secure international eminence, some having already done so. In making this proposal I am thinking not merely of the interests of Section II, but also of the benefit that would accrue to the Society as a whole. By thus enlarging its scope it would become more truly representative of the intellectual life of Canada, and would win wider recognition from the international academies of science and letters.

La Littérature au Canada français, 1882-1932

Par le Chanoine Emile Chartier, F.R.S.C.

Au moment où le marquis de Lorne fondait l'Académie canadienne ou *Royal Society of Canada* (1882), les courants littéraires qui avaient jusque-là entraîné la pensée du Canada français étaient presque tous fixés.

En prose, les genres sont nés, les uns après les autres, sous la poussée de notre évolution politique. La littérature d'observation, contenue dans les *Relations* des missionnaires ou voyageurs et dans les *Mémoires* des gouverneurs ou administrateurs, couvre toute la période française de notre existence nationale (1608-1760). Le lendemain de la conquête (1760-1792) ne connaît presque pas d'autre manifestation littéraire que celle de notre folklore ou de nos contes et chansons, héritage de l'époque précédente, qui constituaient, à côté de sa littérature livresque, la littérature populaire. Avec l'octroi de notre première charte politique (1791), surgissent deux genres éminemment appropriés à l'obtention de nos libertés constitutionnelles, l'éloquence parlementaire et le journalisme; ils se développent presque seuls au cours de la période qu'on a appelée justement l'*Histoire de cinquante ans* (1790-1840). La rivalité occasionnée par l'Acte de 1840, entre deux peuples différents d'esprit, de croyance et de langue, engage nos écrivains dans une voie nouvelle; pour prouver que nous ne sommes pas inférieurs à nos émules au moins comme agents de civilisation, ils ne croient mieux faire que de recourir au témoignage de l'histoire (1840-1867). Et, quand la constitution fédérale de 1867 eut résolu définitivement notre problème politique, les préoccupations économiques et sociales firent naître une littérature inspirée d'elles (1867-1880).

En poésie, deux courants de pensée se font la lutte dès le début, c'est-à-dire vers 1800. Les uns, ne regardant que du côté de la France, veulent importer ici les seuls sujets qui passionnent les âmes poétiques d'outre-mer. Les autres, enthousiasmés par les promesses d'avenir que leur révèle notre pays, rêvent de se cantonner dans le nationalisme. Mais, gallicisants et humanistes ou régionalistes, ils ne peuvent échapper aux deux écoles qui régentent la poésie française telle qu'ils la connaissent. Or, de 1800 à 1855, il n'existe encore pour eux que le classicisme du XVIIe siècle et le pseudo-classicisme du XVIIIe. On voit donc Michel Bibaud pasticher alors, avec les lourdes *Epîtres et Satires* de Boileau, les oeuvres légères de Parny et de

Delille. Puis, en 1855, *la Capricieuse* nous révèle l'existence du romantisme dont Crémazie rapporte de France les principales oeuvres en 1856. Aussi, entre 1855 et 1882, l'*Ecole* épique ou patriotique *de Québec* se met-elle à la remorque de Lamartine et de Hugo, de Delavigne et de Musset, de Béranger et de Gautier.

En 1882, lors de la fondation de l'Académie canadienne, c'est encore l'*Ecole de Québec* qui tient le haut du pavé dans notre cité poétique. Elle y règnera et y perpétuera le romantisme jusqu'à ce que, vers 1895, l'*Ecole littéraire de Montréal* nous initie aux arcanes du Parnasse, puis aux mystères du symbolisme.

Pourtant, notre *Ecole de Québec* ne procédait pas d'une unique inspiration. Continuant la scission qui existait entre leurs prédécesseurs, ses adeptes se divisent en deux classes. L'une, qui se cantonnerait volontiers dans le régionalisme, adopte pour guides Chauveau, Beauchemin et Lemay; elle manifeste, à leur exemple, une tendance psychologique et moralisatrice. L'autre, mêlant à ceux de chez nous les sujets de l'étranger, s'exprime par la voix des héritiers de Crémazie, par celle de Fréchette et de Chapman, et prend volontiers à leur suite le ton de l'éloquence.

C'est au régionalisme, cultivé dejà par Lenoir, Gérin-Lajoie, Fiset, Routhier et Gingras, qu'appartiennent Rémi Tremblay, Adolphe Poisson, Sulte, Evanturel, Chouinard, Legendre, Caouette, Roy et Marchand. La douceur de Lemay synthétise l'allure presque pastorale de cette école, comme l'art du développement chez Beauchemin et l'intensité de l'emotion chez Alfred Garneau en expriment la caractère poétique.

Au contraire, la tonnante verbosité de Chapman exagère ce qui fut la marque de notre école oratoire. Le spectre de Victor Hugo hante évidemment le studio du Fréchette première manière, où il voisine avec le Chateaubriand de la *Nuit en Amérique*. Desaulniers, l'un des derniers héritiers de ces maîtres, ne se fera pas faute de les suivre, dans des pièces de facture achevée comme *Le Golfe*, par exemple.

A partir de 1895 environ, l'*Ecole littéraire de Montréal* se substitue à son aînée. L'inspiration change du tout au tout; nos poètes deviennent alors successivement les tributaires du Parnasse et du symbolisme.

C'est à Leconte de Lisle, de Hérédia et Sully Prudhomme, qu'il faut rattacher Charbonneau, Vézina, Beauregard et Leconte, Michaud, Beaulieu, Doucet, Ernest Tremblay, Ferland, Desjardins, Chopin, Jules Tremblay et Paul Morin.

Au contraire, Helbronner, Charles Gill, Nelligan, Louis Dantin,

Lapointe, Cinq-Mars, Duval, Delahaye et Dreux s'apparentent davantage à l'école de Rimbaud et des verlainistes.

Depuis quelques années enfin, un nouveau courant semble s'être établi. Sous le chatoiement du vers parnassien ou la solidité du vers classique, Lucien Rainier et l'abbé Lacasse se complaisent dans un mysticisme profondément humain, comme Robert Choquette et Alfred Desrochers dans la description de notre incomparable nature. Un groupe féminin tout récent (Simone Routier, Alice Bernier, Eva Senécal, Alice Lemieux, Hélène Charbonneau) se livre à des effusions qui, procédant le l'introspection, voudraient exhaler l'âme humaine elle-même. Il complète l'école rustique qui, avec Léveillé, Alphonse Desilets et Blanche Lamontagne, se bornait à chanter, à la façon de Coppée, la vie des humbles.

C'est la vie de nos "habitants" que détaillent aussi nos romanciers; ils suivent en cela le Gérin-Lajoie qui avait écrit cette épopée rurale: *Jean Rivard le défricheur* et *Jean Rivard l'économiste.*

L'entreprise, avouons-le, n'est pas des plus faciles. Dans les personnages que l'on met en scène, c'est l'âme qu'il faut atteindre, parce que c'est elle qui intéresse le lecteur. Or, il n'est guère de psychologie plus compliquée que celle du paysan canadien-français, faite à la fois de confiance absolue en la Providence et de nonchalance presque fataliste, hantée du goût de l'aventure et cédant volontiers au *far niente*, foncièrement honnête et pourtant rouée à la normande, familière avec les préoccupations religieuses et cependant crédule envers toutes les superstitions, autoritaire dans ses jugements, fondés sur une instruction souvent rudimentaire, et néanmoins prête à suivre toute doctrine qui, se targuant d'absolu, s'exprime avec de grands mots.

Ces personnages, c'est sur notre scène à nous qu'il faut les faire évoluer. Les uns, au lieu de représenter cette scène avec le scrupule minutieux du peintre, lui appliquent les couleurs qu'ils ont empruntées aux maîtres romanciers du dehors. Ces couleurs étrangères, trop peu voyantes, mentent à nos paysages luxuriants ou sauvagement rustiques. Les autres, tout en observant nos décors, ou bien ne savent pas assez en distinguer les nuances infiniment variées ou bien, les ayant distinguées, ignorent trop l'art suprême de les fondre en ce tout harmonieux qui caractérise la nature telle que Dieu l'a faite.

Sur cette scène, c'est par leurs gestes, et par leurs paroles plus encore, que les personnages doivent manifester les passions qui les agitent. Il arrive cependant que l'auteur, au lieu de les mettre au premier plan, se plaise à philosopher lui-même, soit qu'il parle à leur place soit qu'il se serve d'eux comme d'un mégaphone pour exprimer

ses propres conceptions. Si c'est eux qui paraissent, il arrive que, parlant sa langue au lieu de la leur, il leur prête des façons de s'exprimer qui leur sont inconnues; ou inversement que, trop peu familier avec leurs manières de dire, il ne leur attribue pas les conversations qu'ils ont coutume de tenir entre eux.

Peu de nos romans ont opéré la fusion difficile de ces trois éléments. Tel n'a souci, ou à peu près, que de psychologie; dans ce domaine, Laure Conan a laissé une oeuvre profondément creusée. Chez d'autres, prédominent la description de la nature et le portrait des personnages; et là on ne peut que s'incliner devant des oeuvres aussi poussées que celles de l'honorable Ernest Choquette sur la région du Richelieu, de Robert Choquette sur notre Nord montréalais, d'Harry Bernard sur le district de Saint-Hyacinthe, de Léo-Paul Desrosiers sur la région de Berthier, du Père Dugré sur la double presqu'île des Trois-Rivières. Quant au langage de nos gens, à la reproduction duquel s'était essayé Hector Bernier, il a fallu attendre la *Maria Chapdelaine* de Hémon et la *Vie en rêve* de Dantin pour voir des auteurs le souder avec art à leurs propres récits.

C'est cette difficulté, d'opérer la fusion entre les éléments du roman rural, qui a sans doute porté quelques-uns de nos écrivains à déserter la campagne et à prendre pour thèmes de leurs romans des problèmes politiques ou nationaux. Un homme qui déjoue la franc-maçonnerie et renonce au premier poste de son pays après avoir garanti, dans une constitution nouvelle, les droits de sa race et de sa foi; un autre qui, pour se rattacher à ses origines nationales et religieuses, brise du même coup son foyer et sa carrière politique: tels sont les deux héros, Lamirande et Lantagnac, qui mènent l'action dans le *Pour la Patrie* de Jules Tardivel et l'*Appel de la race* de Alonié de Lestres. Mais l'hypothèse posée par Tardivel est-elle bien vraisemblable dans un pays comme le nôtre? et Lantagnac n'aurait-il pu atteindre le même résultat sans occasionner la rupture de son bonheur? Telles quelles, les deux oeuvres révèlent une aptitude profonde à saisir les ressorts qui agitent les âmes, une grande maîtrise de la langue et du style, une puissante faculté d'observation. Dans notre monde matérialiste, où les problèmes désintéressés risquent d'être noyés dans le flot des intérêts économiques, elles tiennent devant l'opinion des préoccupations que notre race se doit de maintenir au premier plan.

Elles sont plus opportunes en tout cas que celles qu'agite M. le juge Routhier dans *Le Centurion* et *Paulina*, deux oeuvres filles de ce genre hybride, le roman biblique. Quoi qu'on fasse, on perdra toujours à vouloir faire apparaître, sur un théâtre où le roman produit tant d'énergumènes, la figure austère et douce du Christ. Quelque

intérêt que comporte la reconstitution d'une société vénérable par son antiquité plus que par ses moeurs, on n'aime pas à voir Dieu ramené aux proportions d'un homme et des textes sacro-saints associés à une intrigue par trop profane.

La place de l'histoire judaïque, comme celle du dogme, est dans la chaire. Elle est aussi dans les oeuvres d'hommes que leur caractère et leurs études rendent les propagandistes autorisés de la pensée de l'Eglise. Pas plus que la profane, l'éloquence religieuse n'a manqué chez nous de représentants. Une histoire littéraire qui offre les noms de Mgr Antoine Racine, de Mgr Louis Laflèche, de Mgr Adélard Langevin et de l'abbé Gustave Bourassa, pour ne parler que des morts, peut être satisfaite d'elle-même; la voie ouverte par l'abbé Holmes a été royalement suivie. Il faut ajouter, à cette lignée d'orateurs proprement dits, le théologien-orateur qu'est Mgr Louis-Adolphe Pâquet. Par la profondeur de la pensée, par la justesse des applications que comporte sa haute doctrine, par la dignité de son style et la pureté de son verbe, marqué du sceau de la grande époque, Mgr Pâquet se place au rang des plus nobles interprètes de l'Eglise.

C'est un autre genre d'éloquence que pratiquent nos parlementaires et nos politiques les plus en vue. Parmi les successeurs de Papineau, de Lafontaine et de Cartier, quelques différences radicales qui distinguent Laurier, Chapleau, Mercier, sir Lomer Gouin, les honorables Lemieux, Chapais, Lapointe, et M. Henri Bourassa, il y a un terrain sur lequel tous se rencontrent. Ardents, comme tous les Français, à remonter aux idées et aux principes abstraits, au risque de s'égarer quelquefois dans les nuages ou le verbiage, ils ne négligent pas, suivant en cela l'exemple de nos compatriotes anglais, de descendre à des conclusions pratiques. Les théories avec lesquelles ils se jouent, ils les appliquent aux multiples problèmes constitutionnels, économiques ou sociaux, que chaque jour soulève chez un peuple en pleine évolution ou du moins en pleine formation. Ils joignent donc au feu intérieur, qui consume leurs âmes françaises et qui éclate souvent en fusées brillantes, le sens des réalités. Ce sens leur fait traiter, avec la froideur et la précision d'un Anglais, les questions les plus terre à terre du commerce, de la finance, de l'industrie ou du travail. Il est surtout une cause autour de laquelle se rallient tous les politiques du moins de notre province: celle de notre instruction. Autant ils manifestent sur ce terrain de largeur de vues en faveur de nos compatriotes d'autre langue et d'autre foi, autant ils témoignent de jalousie pour conserver à leur élément national la main-mise sur son système d'éducation, autant ils mettent de zèle à faciliter l'instruc-

tion au plus grand nombre d'esprits, même aux classes les moins élevées de notre société.

Quant à notre éloquence académique, nous n'avons pas lieu d'en rougir. Etudes lues dans nos Instituts de sciences et de lettres, harangues prononcées dans les cérémonies nationales, discours de circonstances qui se débitent après nos banquets multipliés, tous ont ce trait commun—à moins qu'on ait contraint l'orateur à les improviser sur place—d'être préparés avec le soin que les Français eux-mêmes y apportent. Ils se distinguent par le souci de dégager la pensée de fond qui anime les convives ou les auditeurs, par la correction de l'expression, le brillant des images, la clarté et l'ordonnance des idées, parfois aussi la finesse de l'esprit. Certains recueils de discours et conférences, comme ceux des honorables Routhier et Chapais, de l'abbé Bourassa ou d'Edouard Montpetit, ne dépareraient pas une bibliothèque des meilleurs recueils français. Il est tel de ces orateurs d'occasion qui, dans une circonstance donnée, a été l'écho des sentiments de sa race, tout comme l'avait été Crémazie quand il accueillait, par son évocation du *Vieux soldat canadien*, en 1855, "la Capricieuse" et son commandant de Belvèze ou quand il faisait flotter, en 1858, le *Drapeau de Carillon*.

Peut-on en dire autant de notre littérature scientifique, de notre littérature mêlée et surtout de notre journalisme?

Par l'effet de notre tempérament, par suite aussi de la tradition, nos journalistes sont des combatifs. Le journal est un champ clos où ils se croient le devoir de porter, chaque matin ou chaque semaine, des bottes à l'ennemi réel ou prétendu. Ne parlons pas de la partie "nouvelles", où souvent l'insignifiance des faits n'a d'égal que le négligé de leur présentation. Mais, là où s'exprime le conflit des idées, nous ne sommes pas si inférieurs. Il se peut que la couleur politique du rédacteur lui fasse exagérer parfois l'iniquité de ses adversaires, qu'elle lui obscurcisse la vue au point qu'il ne distingue plus bien le principal de l'accessoire, l'erreur de la pensée et l'impropriété de l'expression. L'obligation d'écrire vite et la tentation de frapper fort peuvent aussi l'empêcher de mesurer la portée de chaque phrase. Il reste cependant que beaucoup d'entre nos journalistes, Tardivel, Tarte, Chapais, Trudel, Bourassa ont élevé leur journal à la hauteur d'une véritable institution. Les maîtres du journalisme français, tenant compte d'une éducation familiale parfois rudimentaire et d'une instruction acquise souvent en dehors de l'école, reconnaîtraient ici des héritiers non seulement de leur clarté d'esprit, mais même de l'élévation de leur style.

Les savants français de même ne renieraient ni la compétence scientifique ni la valeur littéraire d'écrivains comme Mgr Laflamme ou l'abbé Henri Simard. Sans rien sacrifier de la précision que réclame l'exposé des recherches de la science, ils ont su la rendre accessible, par l'exactitude et la simplicité de leur verbe, à des esprits assez peu familiers avec les choses de la nature. L'un de nos "scientifiques" a trouvé le moyen de transformer ses mémoires les plus secs de fond tantôt en de véritables chants lyriques tantôt en des drames réels, vivants comme des tableaux. C'est à cette association prestigieuse que le Frère Marie-Victorin doit sans doute d'être considéré comme une autorité dans le monde entier, mais chez aucuns peuples avec plus d'unanimité que chez ceux dont le goût est le plus opposé, les Anglais et les Français.

Autant sont clairsemés ceux qui chez nous se vouent à la science, autant abondent les auteurs de collections qu'on a coutume de grouper sous le nom de *littérature mêlée*. Essayistes et chroniqueurs, auteurs de billets et de silhouettes, rédacteurs de monographies et d'articles d'occasion, beaucoup s'empressent, quand leurs écrits disparates constituent une matière suffisante, de les réunir en volume et de les lancer dans le public sous un titre peu compromettant. Parfois quelques-uns de ces écrits représentent des recherches de première valeur et ont la portée d'un *Essay*, tel que les Anglais le comprennent. Plus souvent ce sont des fusées auxquelles la gravité de la circonstance qui les a fait lancer prête un éclat durable. Mais, d'ordinaire, ce sont jeux de dentelles inspirés par l'actualité du jour et qu'emporte, pour les noyer à jamais dans son cours, l'actualité du lendemain. Tous ces recueils attestent trop souvent le peu de souffle de leurs auteurs et menacent, excepté ceux de leurs articles qui touchent à des questions toujours brûlantes, de faire long feu. Ils prouvent du moins l'activité littéraire des nôtres, leur ambition d'ajouter à notre bagage intellectuel, leur souci d'agir, au delà du moment présent, sur l'esprit du lecteur.

Le genre qui semble avoir exercé parmi nous le plus d'empire, pris le plus d'extension et acquis le plus de perfection, c'est la critique littéraire.

Longtemps celle-ci se borna à des observations lexicologiques ou syntaxiques. Cette critique purement grammaticale prouvait du moins le respect que ses partisans professaient eux-mêmes, et qu'ils voulaient inspirer aux autres, à l'égard de Sa Majesté la langue française.

Puis, ce fut l'ère de la critique personnelle. Délaissant comme à son insu les sujets abordés et la façon de les présenter, celle-ci se faisait

un jeu de s'en prendre aux auteurs. Ce n'était pas cependant leurs qualités intellectuelles ni leur valeur littéraire que l'on cherchait à découvrir et à mesurer; trop souvent leur allégeance politique devenait le fondement d'une admiration sans mélange ou d'une horreur sans bornes. Quelquefois même, dressant de sa propre autorité un code moral fantaisiste, on alla jusqu'à trouver les écrivains en conflit avec des doctrines que ni les Eglises ni les philosophies n'eussent voulu appuyer de leur autorité. Et parce que enfin quelques-uns, le *genus irritabile vatum* surtout, ne voilaient pas assez le décalque qu'ils se permettaient envers leurs maîtres d'outremer, la critique personnelle glissa dans ces marais d'injures que sont *Le Lauréat* et *Les Deux Copains*.

Aujourd'hui une partie de notre critique adopte une attitude tout aussi peu louable. Ce n'est plus d'être des plagiaires, donc des hérétiques littéraires, que l'on reproche à certains de nos auteurs. On leur reproche plutôt, en certains quartiers, de tenir encore soit aux préceptes qui régissaient le goût jusqu'ici soit à la morale qui de tout temps fut celle des simples honnêtes gens; on les blâme donc d'être moraux ou classiques. On leur en veut de ne pas prendre leurs sujets dans les bas-fonds de la société ou, quand ils s'avisent de les y cueillir, de pallier la laideur du sujet en le traitant avec discrétion. Cette critique, qui écarte les bornes jusqu'ici imposées à l'inspiration par le goût et la morale, s'exprime chez les uns avec un déplorable laisser-aller; chez d'autres, elle s'associe avec une dialectique et une réserve auxquelles on doit rendre hommage. Il reste cependant à se demander si une certaine littérature a beaucoup contribué au prestige extérieur de la France en se révoltant contre l'héritage d'un noble passé et en substituant, au réalisme classique et romantique, le naturalisme nauséabond d'un Zola ou les crudités bestiales d'un Léon Daudet.

Entre ces deux Ecoles s'interpose un groupe qui paraît bien vouloir se tenir à mi-chemin de l'une et de l'autre. Né vers 1900, ce groupe délaisse la personne des écrivains pour ne s'attacher qu'à leur oeuvre. Dans cette oeuvre, il signale sans doute des faiblesses toujours faciles à découvrir; il recherche surtout les réussites susceptibles de révéler quelle direction doit suivre le talent de l'écrivain pour réussir toujours. La critique des beautés, chère à Chateaubriand, supplante ici la critique des défauts. La règle qu'on applique pour mesurer les succès, ce n'est pas la sympathie plus ou moins grande qu'on éprouve pour l'auteur; ce n'est pas non plus son inféodation plus ou moins étroite à telle ou telle église dont on est soi-même le fidèle. On cherche la proportion, l'eurythmie, entre les choses dites et la façon de les dire, entre le sujet et son expression. La comparaison ainsi faite, on est à

l'aise pour signaler à l'auteur, d'après la nature de son talent et le caractère de sa formation, en quel sens il doit diriger son effort pour faire oeuvre durable. Cette critique, pour comprendre l'oeuvre qu'elle apprécie, lui applique tout à la fois la méthode biographique d'un Taine, la méthode dogmatique d'un Brunetière, la méthode comparative d'un Sainte-Beuve.

Elle se distingue par sa haute compréhension, ses vastes connaissances, son sens de la mesure. Ce n'est pas elle qui écarte les modèles classiques, sous prétexte qu'ils sont surannés; ce n'est pas elle qui prône les seuls écrivains récents, à cause de leur prétendue modernité. Elle ne dédaigne ni la variété de procédés d'un Flaubert ni l'acuité d'observation d'un Balzac ni la richesse rythmique d'un Hérédia ou d'un Prudhomme ni l'expression passionnée d'un Verlaine. Mais elle ne jette non plus par dessus bord ni l'équilibre d'un Bossuet ni la noblesse d'un Corneille ni la douceur d'un Racine ni même la finesse d'un Voltaire.

C'est à cette école que nos écrivains doivent peut-être leurs meilleures inspirations. C'est qu'au lieu de les fustiger, elle préfère les diriger; au lieu de les apprécier seulement, elle se fait un devoir de les encourager. Ce sera le mérite de Mgr Camille Roy, par la netteté de ses vues, et la modération de ses jugements, de Louis Dantin, par l'étendue de sa culture et la chaleur de sa sympathie, d'avoir stimulé beaucoup de vocations littéraires, d'avoir ramené dans leur vraie voie d'autres qui menaçaient de s'égarer.

Dans cette activité littéraire de cinquante années—où le théâtre et la critique théâtrale ne se sont pas encore fait leur juste place—, quelle fut au juste la part de notre Académie canadienne ou *Société royale*?

Au lieu de siéger en permanence, comme l'Académie française, ses membres ne se réunissent qu'une fois par année et ils ne contribuent même pas tous à l'intérêt de ses séances. Pour ces raisons, l'on ne peut dire qu'ils aient comme tels exercé sur nos courants littéraires une action constante.

Toutefois, faisons attention que les figures les plus en vue de notre monde intellectuel, les écrivains qui chez nous ont fait autorité pendant ces cinquante ans, appartiennent presque tous à la Société. Indirectement, celle-ci a donc aidé le mouvement. A parcourir ses *Mémoires* annuels, on constate que plusieurs d'entre eux ont sonné à l'heure opportune le coup de cloche nécessaire. Certains de nos livres les meilleurs avaient d'abord été présentés à la Société, par chapitres détachés, comme la contribution annuelle de ses membres à son activi-

té. Certaines directions, qui ont été les plus efficaces sur les esprits adonnés à l'art d'écrire, sont contenues dans les discours ou exposés que leur fonction de présidents imposaient aux plus remarquables de ses sociétaires.

Tant qu'elle ne sera pas une institution siégeant en permanence, on ne peut demander à notre Académie canadienne de faire davantage. Elle ne peut que noter les efforts et en mesurer la valeur, indiquer des voies à prendre ou à continuer de suivre, encourager les fidèles de la pensée soit par ses approbations soit par ses exemples. Elle tient son rôle en signalant le mérite, jusqu'à ce qu'elle devienne l'école où se formeront, sous la conduite de maîtres reconnus, les

Austères travailleurs de la sainte corvée (Fréchette).

Ceux-ci travailleront avec d'autant plus de zèle qu'ils possèdent maintenant une direction. Depuis 1900 environ, la doctrine de la *nationalisation* s'est vigoureusement implantée parmi nous. Notre poésie ne saurait sans doute se dégager des procédés auxquels se plient les poètes français; mais, au lieu d'emprunter ses images aux landes de la Bretagne ou aux plaines de la Normandie, elle peut les puiser dans notre nature si riche et si mobile. Nos journalistes n'ont plus à remplir leurs colonnes des seuls faits divers qui alimentent le journalisme européen; ils trouvent chez nous une matière abondante à leurs réflexions quotidiennes. Nos orateurs, sans négliger le culte des idées générales, doivent les appliquer encore davantage à la solution de nos problèmes locaux. Et nos critiques enfin trouvent, dans la production nationale, de quoi susciter leurs études, sans être obligés de se rabattre sur l'immense production de la librairie étrangère.

L'heure approche, semble-t-il, où l'apostrophe de Charles-ab-der-Halden* ne sera plus une invitation, mais un fait: "Littérature canadienne, ne cherche pas les lointains pays. Au Gange, préfère le S.-Laurent. Observe la vie des *habitants* au milieu desquels tu vis. Dis-nous les splendides paysages du pays natal—tu pourras en tirer les éternels accents de l'âme humaine. Laisse les chiffons qui sortent de nos magasins de nouveautés, et va, Canadienne aux jolis yeux doux, va boire à la claire fontaine!"

Essais, pp. 124-125.

Cinquante ans d'histoire au Canada français

Par Aegidius Fauteux, M.S.R.C.

Il y aura bientôt un siècle, dans un rapport resté célèbre quoiqu'il ne soit plus aussi unanimement vanté, lord Durham jetait cette courte phrase qui a fait couler tant d'encre depuis: "Les Français du Bas-Canada sont un peuple sans histoire ni littérature." L'assertion était brutale, peut-être même froidement dédaigneuse, mais nous sommes obligés de reconnaître qu'elle n'était pas là moins bien fondée entre tant d'autres hasardées par notre gouverneur. En 1839, il n'y avait en effet que deux ans que Michel Bibaud avait publié la première Histoire du Canada qui prétendit s'élever au-dessus de l'enfance scolaire, et, à relire aujourd'hui cet effort, méritoire sans doute, mais assez malhabile, l'on n'a pas de peine à se convaincre avec lord Durham que, pas plus qu'une hirondelle ne fait le printemps, il ne suffisait à lui seul à constituer une littérature historique.

Là cependant où le noble lord s'est grossièrement trompé, c'est lorsque, s'autorisant de cette absence de littérature et d'histoire qui avait pourtant de si nombreuses excuses, il a cru pouvoir prophétiser la ruine prochaine de notre race. "Dans ces circonstances, concluait-il, je serais en vérité surpris si les plus réfléchis d'entre les Canadiens-français entretenaient à présent aucun espoir de conserver leur nationalité."

Certes, il avait mille fois raison de prétendre qu'un peuple, du fait qu'il ne sait plus son passé, c'est-à-dire les gestes et la pensée des ancêtres, perd ses raisons même de vivre et est tout près de périr, mais il avait compté sans les Canadiens-francais qui, tout en n'ayant encore en son temps qu'un sens un peu confus de leur histoire, en possédaient cependant déjà le culte inné et profond. Et lord Durham s'est si bien trompé qu'au moment même où il niait si catégoriquement l'existence des études historiques en notre pays, il ne faisait, sans s'en douter, qu'en décréter la naissance. Sa phrase fameuse et si souvent repétée à été comme le coup de fouet qui, en l'atteignant dans sa fibre la plus sensible, a réveillé l'âme canadienne et lui a fait rendre un son qui retentit encore. Qu'est-ce en effet que l'Histoire de Garneau, sinon une réponse aussi directe qu'éloquente au Rapport encore frais de 1839? En s'attelant à la tâche formidable de construire de toutes pièces, avec des matériaux épars et difficilement accessibles, l'édifice encore inexistant de l'histoire canadienne, l'illustre auteur a eu précisément pour objet de créer entre le passé et le présent cette

solidarité sans laquelle on venait de nous solennellement prévenir qu'il ne peut y avoir de conscience nationale. Et l'on sait comment d'autres l'ont suivi, dans la même ferveur patriotique, mais aussi dans le même amour du vrai, les Ferland, les Laverdière, les Gérin-Lajoie, les Turcotte.

Vers 1880 quarante ans à peine étaient passés depuis le reproche exact mais un peu cruel de lord Durham, et dejà l'on ne pouvait plus dire que les Canadiens-français étaient un peuple sans littérature et sans histoire. Dans ces deux grandes provinces de travail intellectuel de vaillants pionniers avaient battu la route, l'avaient même constamment élargie et l'avaient déjà brillamment jalonnée de remarquables travaux. Cependant, quelque significative que fut la vitalité deployée, quelque prometteur que fut l'effort jusque là accompli, ce ne pouvait être encore qu'une enfance de la littérature et de l'histoire. A l'une et à l'autre il restait à se faire des muscles et à s'élargir un cerveau. Mais comment activer cette croissance, comment hâter le plus possible cet acheminement vers la maturité rêvée? Chacun sait comment un petit groupe d'esprits agissants, de concert avec le marquis de Lorne, l'un de nos plus avisés gouverneurs, crut servir utilement ce résultat en créant une société qui exercerait une sorte d'hégémonie au moins morale sur l'activité intellectuelle en notre pays et, en servant d'asile en quelque façon officiel à l'histoire, à la littérature et aux sciences, devrait contribuer considérablement à agrandir ce triple domaine. Cette société, ou cette Académie, c'est la Société Royale du Canada qui célèbre précisement cette année le premier cinquantenaire de son existence. Quels ont été jusqu'ici les fruits directs ou indirects du magistère que la nation elle-même a daigné lui confier, quels ont été, dans les divers champs d'action intellectuels, les progrès accomplis, sinon par elle toujours, du moins sous son ombre tutélaire? Il lui semble que l'occasion était bonne de le rechercher après cette première et imposante étape d'un demi siècle qu'elle vient de fournir.

Que l'on me permette donc, suivant le rôle qui m'a été à moi-même assigné, d'étudier brièvement le mouvement historique canadien dans les derniers cinquante ans, et particulièrement ce mouvement historique tel qu'il a évolué chez les Canadiens français que représente notre section dans le large organisme de la Société Royale.

En dépit de ce que le procédé peut avoir d'un peu arbitraire, je partagerai, au point de vue des études historiques, les derniers cinquante ans en deux périodes, l'une qui va de 1880 ou environ jusqu'à 1900, et l'autre qui va de 1900 jusqu'à nos jours.

La première de ces périodes retiendra moins longtemps notre attention car, bien qu'elle ait eu elle aussi son éclat, on sent qu'elle

n'a fait que prolonger l'espèce d'incubation commencée vingt ou trente ans plus tôt. Les ouvriers d'abord y furent peu nombreux. C'est à peine si, durant toute cette époque, l'on trouve à inscrire au catalogue de l'histoire une vingtaine de noms, dont quelques-uns, il est vrai, méritent au plus haut point notre respect. Mais ce qui frappe surtout chez la plupart de ces historiens de la deuxième heure, c'est, sans parler d'une documentation insuffisante qu'excuse encore la relative inaccessibilité des archives, l'absence presque complète de la méthode historique. Tous ils ont le culte fervent du passé et s'appliquent à le glorifier avec la plus louable ardeur, mais tous, même parmi les mieux réputés, n'ont pas encore appris à maîtriser les lois nécessaires qui régissent l'histoire, loi d'exactitude, loi de discernement, et surtout loi d'absolue probité.

C'est ainsi qu'il y a trois noms principaux dont on peut dire qu'ils dominent l'histoire canadienne durant toute cette période de 1800 à 1900, ceux de sir James Lemoine, de Benjamin Sulte, et de l'abbé Henri-Raymond Casgrain, et tous les trois, en dépit d'incontestables mérites, ont été malheureusement des historiens incomplets.

Pendant toute une longue et remarquable carrière, Sir James Lemoine s'est complu à aborder une infinité de sujets historiques et il les a uniformément traités avec une verve charmante, mais, parce qu'il ne s'est délibérement laissé guider que par l'imagination ou par le sentiment et parce qu'il ne s'est jamais préoccupé qu'un fait fut vrai ou faux dès qu'il était pittoresque ou galant, il devra se contenter de n'être devant la postérité qu'un aimable conteur.

Benjamin Sulte, au prix d'un labeur acharné dont il y a bien peu d'autres exemples, a accumulé pendant près de soixante ans une oeuvre plus considérable encore, a répandu dans plus de 2000 articles et d'une cinquantaine de volumes des milliers de faits nouveaux intéressant notre histoire et a surtout rendu d'inappreciables services en mettant au jour de précieux documents inconnus avant lui, mais, parce qu'il est évident qu'il écrit quelquefois plutôt pour son amusement particulier que pour l'information du lecteur, parce qu'il supplée trop souvent à l'absence de preuves par une hardiesse d'information vraiment déconcertante, parce que enfin, dans son gargantuesque appétit, il a englobé beaucoup plus qu'il ne pouvait digérer, le malheur veut qu'il ait ainsi rendu difficilement utilisable une partie considérable de son oeuvre et que, dans beaucoup de cas, il ne soit plus considéré aujourd'hui que comme un guide peu sûr.

L'abbé Casgrain est encore un de ceux qui ont su se tailler une place de premier choix parmi les historiens de leur temps. Il a plaidé éloquemment la cause de quelques unes de nos gloires nationales dans

plusieurs ouvrages justement appréciés qui témoignent de sa diserte faconde en même temps que de son patriotisme ardent, et son moindre mérite ne sera peut-être pas de nous avoir fourni, même en sa forme imparfaite, l'inestimable collection des manuscrits de Lévis. Malheureusement il ne s'est pas toujours souvenu que dans le grand laboratoire de l'histoire où s'élabore le vrai, suivant le mot d'un illustre érudit, la probité est un titre d'admission plus indispensable que l'habileté elle-même; il ne s'est pas toujours souvenu que la plus petite dissimulation ou l'altération la plus légère dans les faits que l'on raconte ou dans les documents que l'on cite sont des crimes de lèse-conscience historique que rien ne saurait excuser, pas même un motif patriotique, religieux ou moral. Et c'est pour l'avoir quelque fois oublié que l'abbé Casgrain a déjà perdu la moitié de ses droits à la pleine confiance qu'auraient pu lui faire les historiens à venir.

Ces quelques réserves faites, il n'en reste pas moins que certe première période de 1880 à 1900 a fourni à notre histoire un indiscutable appoint. Plusieurs bons ouvriers ont contribué à élargir considérablement nos connaissances historiques en déterrant de nouveaux matériaux et en jetant une lumière plus nette sur une foule de points obscurs. Après l'abbé Casgrain dont le *Pélerinage au Pays d'Evangeline*, *Les Sulpiciens en Acadie*, *Une Seconde Acadie* et surtout le *Montcalm et Lévis* disent assez la haute valeur, après Benjamin Sulte dont il serait trop long de citer les nombreuses études qui entourent *l'Histoire des Canadiens français*, son ouvrage capital, après Sir James Lemoine dont *l'Album Canadien* et les *Monographies et Esquisses*, à côté d'ouvrages anglais plus nombreux encore, ne laissent pas de nous apprendre beaucoup, même à travers un brouillard de légende, il serait injuste de ne pas signaler un abbé Bois, dont les travaux sur Sillery, sur Sarrazin et sur l'île d'Orléans sont autant de contributions précieuses à notre histoire et un abbé Verreau qui, sans avoir beaucoup produit lui-même a fait plus que tous les autres peut-être en son temps comme animateur et comme propagateur des études historiques. Dès cette époque aussi, M. l'abbé Gosselin par ses excellentes monographies de Jean Bourdon, et de Jean Nicolet, N. E. Dionne par sa Nouvelle France, Ernest Myrand par son Sir William Phipps, et Ernest Gagnon, par son Château St. Louis préludaient magnifiquement aux travaux plus considérables encore que nous réservait leur maturité. Je regrette de passer sous silence d'autres noms également méritoires qui vaudraient d'être au moins mentionnés, mais, avec les restrictions que les circonstances imposent, il ne me reste que l'espace strictement nécessaire pour étudier même sommairement les trente dernières années qui constituent la période la plus vivante de notre mouvement historique.

A partir du début du vingtième siècle, il est facile de se rendre compte qu'il y a pour les études historiques dans le Canada tout entier, et par suite dans notre province de Québec, comme un point de départ nouveau. Dans cette voie jusque là assez ingrate et où seulement quelques rares fervents osaient auparavant s'engager, un plus grand nombre se presse et avec un équipement de mieux en mieux approprié. Un remuement d'activité se dessine qui s'accentuera tous les jours et dont on verra les ondes progresser avec une rapidité étonnante. La marche ascendante de l'histoire est décidément commencée pour ne plus ralentir.

Parmi les causes multiples qui ont déclanché cet heureux avancement, et qui l'ont largement favorisé, il convient de placer au premier rang l'ouverture de nos départements d'archives et leur développement progressif.

Ce furent d'abord les Archives fédérales qui, tout en existant depuis un quart de siècle déjà, ne commencèrent à prendre véritablement de l'ampleur que vers 1905, avec la direction nouvelle du Dr. Doughty. On n'exagèrera jamais trop la part qui revient dans le rapide développement de nos études historiques à cette institution si merveilleusement renouvelée qui, après avoir accumulé en peu de temps des richesses historiques au delà de ce qu'on pouvait rêver, les a, par ses facilités extrêmement généreuses, presque mises dans la main de ceux qui desirent y puiser. Plus tard, Québec, qui ne venait qu'après d'autres provinces mais qui se disposait à regagner admirablement le temps perdu, s'est décidé à sortir des combles où elles risquaient de moisir ses Archives particulièrement précieuses et a eu le bon esprit de les confier aux soins avertis de M. Pierre-Georges Roy qui en a déjà fait un de nos plus vivants foyers d'éducation historique.

Des bibliothèques publiques se sont ensuite ouvertes qui, en apportant aux travailleurs d'aujourd'hui des facilités que leurs devanciers ne connurent pour ainsi dire pas, ont été des agents particulièrement actifs de notre actuel progrès en histoire. Parmi elles, je ne nommerai que la Bibliothèque Saint-Sulpice qui, outre le très riche fonds de Canadiana qui lui appartient en propre, a mis largement à la disposition du public les inestimables manuscrits Baby dont elle a le dépot, et la Bibliothèque municipale de Montréal dont le mérite est d'avoir rendu immédiatement accessible aux chercheurs la précieuse collection Gagnon.

Enfin nos universités, au fur et à mesure de leur expansion, ont cru le moment venu de faire enfin à l'histoire la place qui lui revenait; elles ont établi des chaires et les ont confiées à des professeurs d'année

en année plus compétents qui, après avoir été pliés eux-mêmes par les meilleurs maîtres de l'étranger aux règles de la méthodologie et aux lois de la saine critique, ont pu former à leur tour, selon leur modèle, des historiens dont les oeuvres nous profiteront un jour.

Dans nos collèges même, les mâitres de l'enseignement secondaire ont rivalisé les uns avec les autres de zèle et de sacrifices pour l'aménagement de bibliothèques à fonds historique toujours mieux outillés et il n'y a aucun doute que, par leur enseignement autant que par leur exemple, ils ont beaucoup contribué à éveiller chez la jeune génération étudiante un goût des études historiques qui devra bientôt porter ses fruits.

Un des plus heureux résultats qu'aient amenés toutes ces influences diverses a été de modifier sensiblement et dans un sens meilleur l'esprit avec lequel l'histoire avait été trop souvent abordée jusque là.

Alors que nos historiens d'autrefois, exception faite de Garneau, de Ferland et de quelques autres à qui un sens inné de leur mission a épargné ce danger, se laissaient facilement glisser sur la pente d'un faux patriotisme jusqu'à l'histoire purement subjective, c'est-à-dire tendancieuse et partiale, la tendance est plutôt générale aujourd'hui vers cette histoire objective qui est la seule vraiment digne de son nom et qui a pour unique objet de raconter ce qui fut, *ad narrandum, non ad probandum.* Grâce aux dépots d'archives qui les mettent mieux à même de consulter les sources originales, grâce aux bibliothèques qui les tiennent au courant des travaux serieux déjà faits, grâce surtout aux leçons toutes nouvelles de quelques dirigeants mieux avertis, ils ont déjà appris à reviser nombre de procès que l'on avait cru définitivement jugés, et par le fait même ils ont senti s'éveiller en eux ce sens critique qui avait manqué à trop de leurs devanciers. Ils se rendent compte que pour arriver au vrai même relatif que suppose l'histoire, il existe une méthode dont on ne saurait se passer et ils apprennent à en user de mieux en mieux tous les jours.

Un autre résultat des mêmes heureuses influences que j'ai dites a été d'accroître notablement la quantité de la production historique, tout en en améliorant la qualité générale.

De tous côté on a vu surgir des publications d'une valeur inégale sans doute, mais qui, à peu près toutes, ont ajouté une réelle contribution à notre fonds historique. Des domaines nouveaux ont été abordés qui n'avaient pas encore été touchés jusqu'ici et certains autres, déjà exploités, ont été pour une bonne partie renouvelés.

Dans l'histoire régionale ou locale, par exemple, il convient de distinguer, en ce qui regarde la province de Québec d'abord, les appréciables monographies de M. l'abbé Couillard-Després sur Sorel

et sur la Seigneurie de Saint-Ours, celle de M. l'abbé Auclair sur les Cèdres, et, tout particulièrement les riches études de M. E. Z. Massicotte autour d'une histoire qui n'a plus pour lui de secrets, celle de Montréal; en ce qui regarde l'Acadie française, l'*Acadie* d'Edouard Richard, *La Tragédie d'un peuple* d'Emile Lauvrière, et le *Charles de la Tour* de M. l'abbé Després, trois ouvrages dont le mérite n'a pu être que rehaussé par l'ardente discussion dont ils ont été l'objet; en ce qui regarde enfin le nord-ouest canadien les travaux de M. le juge Prudhomme que l'on jugera un jour indispensables à l'histoire définitive de cette vaste région.

Mais, même après ces importantes publications, l'on ne sera pas surpris que je mette à part dans cette catégorie deux ouvrages qui débordent véritablement l'histoire régionale par leur amplitude et par leur exceptionnelle maîtrise. Je veux parler de l'*Histoire de Sainte-Foye* du regretté chanoine Scott qui est tout un tableau de l'histoire canadienne au 17^{e} siècle et dont on ne peut trop regretter que la deuxième partie soit restée, non pas inachevée, mais enfouie dans les tiroirs de son auteur, et de l'*Histoire de la Seigneurie de Lauzon* de M. J. Edmond Roy, un travail monumental qui témoigne du plus patient labeur, de l'érudition la plus vaste et de la science la plus sûre.

Quant à l'histoire religieuse, ce sera assez montrer combien elle a été elle aussi en progrès que de signaler, à travers beaucoup d'autres, des oeuvres comme la véridique et volumineuse *Histoire de l'Eglise du Canada* de M. l'abbé Gosselin, l'*Histoire de l'Eglise Catholique de l'Ouest* du R. P. Morice, et les *Etudes franciscaines* du R. P. Hugolin.

Notons encore en histoire constitutionnelle les vivantes conférences de l'abbé Groulx sur *Nos Luttes Constitutionnelles* et la thèse de M. Lanctot sur *l'Administration de la Nouvelle-France.*

En histoire économique, si l'on ne doit pas tenir compte des remarquables études de science sociale de M. Léon Gérin qui ne touchent qu'indirectement à l'histoire, je ne trouve à signaler que les deux volumes de M. J. N. Fauteux sur l'*Industrie sous le régime français*, ouvrage qui ouvre de la façon la plus heureuse une voie où personne autre chez nous ne s'était encore engagé.

Le genre biographique a été comme à l'ordinaire abondamment cultivé mais dans quelques cas surtout avec un rare bonheur. Pour l'établir, il suffira de mentionner après le *Louis Jolliet* de M. Ernest Gagnon, les deux maîtresses monographies de *Jean Talon* et de *Montcalm* par l'hon. M. Chapais. A ce chapître de la biographie on m'en voudrait de ne pas signaler aussi le monumental *Dictionnaire*

général du Canada que vient de publier le P. Lejeune après 20 ans de patientes recherches et qui est appelé à rendre à tous les chercheurs d'incalculables services.

Faut-il parler encore des travaux généalogiques qui sont une annexe précieuse de l'histoire? Depuis 1900 surtout dans la province de Québec ils ont pris une ampleur considérable, et quelques-uns, comme ceux de M. P. G. Roy qui se comptent par la vingtaine, dépassent le pur intérêt familial et entrent véritablement dans l'histoire.

Et la petite histoire enfin, comment ne pas en parler? Là encore il faut placer à part M. Pierre-Georges Roy que nous retrouvons depuis 40 ans sur tous les chemins de l'histoire et à qui, quoi qu'il en ait, se trouve irrémédiablement collée l'épithète d'infatigable. Il a réalisé ce miracle de maintenir depuis 1895 le *Bulletin des Recherches Historiques* dont l'utilité est aujourd'hui reconnue indispensable et par ce moyen comme par ses autres publications, il a, pour le plus grand avantage des historiens, désembroussaillé nos annales d'une infinité d'erreurs qui y étaient blotties.

Je regrette que l'espace me manque pour rendre la justice qui leur est due à un grand nombre d'autres bons ouvriers de l'histoire canadienne qui mériteraient ici plus qu'une mention. En Canada, Mgr Amédé Gosselin, MM. F. J. Audet, Victor Morin, Régis Roy, M. l'abbé Caron et M. le juge Surveyer, etc., et en France, MM. Emile Salone, Charles de Roncière, Claude de Bonnault, dom Jamet et le Père de Rochemonteix.

Mais tous ces travaux, si utiles qu'ils soient, ne sont encore que des travaux d'analyse et les travaux d'analyse n'ont en fin de compte pour objet que de préparer le travail supérieur de synthèse qui condense les faits déterrés par la patience des érudits, qui les assemble en un large tableau et qui en tire les conclusions nécessaires. Deux de nos historiens, l'hon. M. Chapais et M. l'abbé Groulx n'ont pas craint de s'attaquer à cette tâche difficile et au jugement de tous ils y ont remarquablement réussi, M. Chapais, avec son *Cours d'Histoire du Canada*, et M. Groulx avec des monographies encore séparées mais où on aperçoit déjà le lien qui unira toutes les parties de l'édifice prochain. On a voulu opposer l'un à l'autre ces deux historiens comme les chefs de deux écoles opposées, en faisant du premier un professeur de conciliation outrancière et du second un professeur de patriotisme non moins outrancier. Ce n'est pas ici le lieu de discuter le mérite plus ou moins fondé de cette opposition. Il suffit qu'il n'y ait qu'une voix pour les saluer tous les deux comme des historiens également

consciencieux, également soucieux de vérité et qui font un honneur égal à notre littérature historique.

Tel est le bilan, peut-être trop succinctement exposé du mouvement historique dans le Canada français depuis 50 ans. Il est assurément consolant, et la Société Royale a particulièrement lieu de s'en féliciter, parce que parmi les ouvrages importants qui la composent il n'en est presque pas un qui n'ait eu pour auteur l'un de ses membres. Sans doute nous ne devons pas nous dissimuler les immenses lacunes qui restent encore à combler, mais il est incontestable que l'histoire chez les Canadiens français est maintenant en bonne voie, et nous avons le droit d'entretenir les meilleures espérances pour le prochain demi-siècle qui s'ouvre maintenant devant elle.

Rétrospective d'economic sociale au Canada français
1882-1932

par Gustave Lanctot, M.S.R.C.

Sous le signe du déterminisme où il est de rigueur d'avoir des ascendants, la science économique aime à nous rappeler qu'elle remonte jusqu'à Montchrétien. De même, en Canada français, conviendrait-il sans doute d'assigner comme ancêtre à l'économie sociale Pierre Boucher, qui publiait en 1664 l'*Histoire véritable et naturelle des moeurs et productions du pays de la Nouvelle-France.* Après cet ancêtre, d'autant plus notable qu'il est de formation canadienne, on pourrait encore citer, également de bonne lignée, Nicolas Denys, dont la *Description géographique et historique des costes de l'Amérique Septentrionale avec l'histoire naturelle du pays*, s'inscrit à la date de 1672. Deux ouvrages parus en France, l'imprimerie n'existant pas au pays, ouvrages auxquels servent d'appoint les *Relations des Jésuites*, voilà tout le bagage du régime français quant aux seuls imprimés. Car il ne faut pas oublier que, sous forme de manuscrits, une documentation économique énorme s'entasse durant cette période, à Québec comme à Versailles, en des mémoires multiples où notre époque n'a pas encore fini de puiser. Parmi les plus complets, aujourd'hui publiés, se rangent ceux de Catalogne, de Boucault et de Bougainville.

Survient la conquête qui concentre presque totalement nos activités intellectuelles autour des buts religieux et politiques. Du moins, par elle nous arrive un imprimeur avec ses presses, d'où sort un premier journal. Grâce à lui se diffuse un peu d'information économique, dont le volume grandira lentement avec les nouvelles feuilles qui vont se créer. Ce n'est tout de même qu'en 1790, et encore par la voie de la traduction, que se risque au grand jour la première publication économique, *Extraits et lettres sur l'agriculture*, portant l'imprimatur de Québec. Il faut atteindre 1815, avant de nous enrichir d'un premier ouvrage important, celui de Bouchette, *Description topographique de la Province du Bas-Canada.* Débordant son titre, il représente une contribution précieuse à l'Économique contemporaine, en particulier, par son abondante documentation agricole. Ce premier essai est encore surpassé par son ouvrage en langue anglaise, *The British Dominions in North America*, de 1832, que suit la même année *A Topographical Dictionary of Lower Canada.* De son contemporain, Amury Girod, on peut encore consulter les *Notes*

diverses sur le Bas-Canada, étude sur les terres, la finance et les voies de communication.

Fortement empirique, notre jeune science trouve enfin son théoricien en Etienne Parent, qui s'en fait le propagandiste, plus éloquent que solide. En 1846, dans une première *Lecture devant l'Institut Canadien*, dont il fait une brochure, il établit l'importance de l'économie sociale, qu'il appelle la "science des progrès par excellence." Devançant nos plus modernes théoriciens, il traite plus tard de l'*Industrie considérée comme moyen de conserver la nationalité canadienne-française*, à quoi il faut ajouter ses brochures sur le travail et les classes ouvrières. Est-ce influence ou coincidence, mais de ce moment date l'apparition de plusieurs ouvrages de bonne facture. Ceux que préoccupent notre situation matérielle, brisant le cadre trop étroit des questions agricoles, élargissent leur champ d'action et s'attaquent à des problèmes plus complexes et plus vastes. De cette activité, il s'impose de retenir l'*Esquisse sur le Canada, considéré sous le point de vue économiste*, de J. C. Taché, la meilleure étude d'ensemble de la période, l'ouvrage de mérite, *La Colonisation du Bas-Canada*, de Stanislas Drapeau, ainsi que les opuscules plus modestes de Joseph Tassé, *La Vallée de l'Outaouais* et de Hubert Larue, *Les Industries de Québec*. La science économique d'expression française prend ainsi contact avec l'actualité et cherche à fournir des directives aux problèmes du jour.

Extrêmement sommaire faute d'espace, cette revue du passé peut-être surérogatoire, permet par contre de fructueuses comparaisons. Elle nous amène à 1882, date de création de la Société royale du Canada. Or, que nous ont apporté les cinquante dernières années dans le domaine de l'économie politique ou plutôt sociale, pour lui donner son qualificatif plus exact et plus moderne? La réponse nécessite des nuances et des commentaires.

Mesurée à l'échelle européenne qui reste la norme idéale, notre production ne s'égale aucunement à celle de nos autres domaines de l'esprit, mais il faut se rappeler que l'Économique attira toujours moins de disciples,—écrivains et lecteurs,—d'où sa moins grande fécondité. Quoiqu'il en soit, dès avant 1882, s'ouvre une période de comparative rétrogression qui finit au début du siècle, période où nos économistes sont des littérateurs ou des professionnels qui font par accident de l'économie sociale. La science survit, cependant, grâce à l'initiative d'une petite avant-garde de travailleurs, qui développent les semences de vie que les pionniers avaient jetées un peu au hasard des questions et des circonstances. Entre les mains de quelques hommes qui, avec des lettres et de la culture, ont pratiqué quelque

peu les économistes, elle s'affirme et se fait une place parmi la production intellectuelle, mais elle n'est pas vraiment la maîtresse de sa maison. Elle exerce son influence, non pas en vertu de sa propre utilité, mais à titre d'auxiliare. Elle reste la servante ou de la politique, ou de la littérature, ou du patriotisme, par exemple. De par son rôle ne pouvant s'élever, elle domine rarement et n'excelle jamais.

De cette situation, il n'est peut-être pas très difficile de fournir une explication. Survivance de l'époque où le commerce dépréciait ses suivants, l'homme d'affaires au Canada français ne pouvait espérer que par une exception assez rare prendre rang parmi l'élite du pays. Après l'exode, à la conquête, de la majorité des officiers supérieurs et des hauts fonctionnaires, il se créa une nouvelle aristocratie, la seule possible d'ailleurs, celle des professions libérales. Il pouvait bien, à l'occasion y pénétrer quelques grands négociants, un Baby ou un Cuvillier, mais le cercle magique se recrutait avant tout parmi les avocats, les médecins et les notaires. Cet ostracisme de la gent mercantile reflétait d'ailleurs un certain snobisme de l'enseignement. Les collèges initiaient aux études classiques, à la philosophie, à l'histoire et se targuaient de former "l'honnête homme," selon la formule périmée du grand siècle qu'ils n'osent encore délaisser que timidement. Quant aux sciences pratiques, les professeurs affichaient à leur égard une superbe qui pouvait ainsi se formuler: A nous, les belles-lettres, aux Britanniques, les affaires. Dans ce dédain, il se glissait sans doute un élément psychologique plus ou moins conscient. Puisque du fait de la condition politique du pays, le capital, venant de Londres, se canalisait en des mains britanniques, sans mentionner les voies que suivaient les entreprises publiques, il était assez naturel d'adopter, devant notre infériorité financière et commerciale, la philosophie, agréable à notre amour propre, des fameux raisins verts. Il semble aussi qu'avec la croissance de la population et le progrès rapide du Canada, notamment dans la banque, l'industrie et les transports, qui s'accompagnent d'un déclin de notre proportion dans la participation aux affaires, une tendance apparaisse chez les Canadiens-français de moins s'intéresser à un champ d'action qui leur échappe. En de telles circonstances où ni l'ambiance ni l'enseignement ne s'y prêtaient, c'est encore merveille que certaines plumes se soient risquées dans ce domaine tabou des affaires et de la statistique.

Cependant la modeste tache d'huile s'élargissait. De plus en plus nombreux, des esprits réclamaient une part plus large, dans l'enseignement et dans les sphères intéressées, pour les études économiques et sociales, armes nécessaires, à côté de la pratique et de l'expérience, dans la lutte de tous les jours, d'autant plus âpre qu'elle

devenait le terrain essentiel de notre évolution. Car, dans le plan moderne du progrès, l'Économique a pris la place des anciennes devises de la religion et de la politique. Au début de cette période se rencontre la brochure d'un membre de la Société royale, M. Paul de Cazes, dont les *Petites notes sur le Canada* forme un excellent épitomé du Canada économique de l'époque. Après lui, un homme d'avant-garde, l'abbé F. A. Baillargé, publie en 1892 le premier traité d'économie sociale d'application canadienne. Simple manuel, sans doute, mais où s'indique quand même une nouvelle tendance. Dans le même esprit, un membre de notre section, M. Joseph Royal, analysait (1894) un peu sommairement *Le Socialisme aux Elais-Unis et en Canada.* Il nous plairait fort d'inscrire ici le nom de MM. Testard de Montigny et Arthur Buies. Leurs ouvrages, *Le Nord* et *Le Nord de Montréal* du premier, et *L'Outaouais supérieur* et *Le Saguenay* du second ont fait connaître ou plutôt ont révélé nos régions du nord, et servi utilement la cause de la colonisation. Mais, en dépit de leur information économique considérable, leurs livres, par suite de leur tournure beaucoup plus littéraire que scientifique, les rangent plutôt dans la catégorie des publicistes que dans celle des économistes. Au contraire, c'est dans cette dernière catégorie, tout en gardant un pied dans l'autre, que doit se classer M. Gaston de Montigny avec ses *Études d'économie politique.* Vers le même temps, sous l'influence des écrits de Paul Leroy Beaulieu se fonde à Montréal, sous la présidence de Sir Louis Jetté, une société d'économie politique dont l'animateur et secrétaire est l'avocat, Mtre Adolphe Chauvin.

Et nous voici au début du siècle présent, possesseurs d'une production assez restreinte et d'un outillage assez rudimentaire. Par bonheur, il survient alors ceci que la propagande des années précédentes commence de porter ses fruits. En ces temps, où la prospérité générale attire notre intérêt et notre convoitise même, un nouveau prophète se dresse, texte en main, pour nous prêcher l'omnipotence du facteur matériel dans la vie des peuples, d'où la nécessité de nous mettre à l'école de l'économie politique. L'auteur de ce programme, est M. Errol Bouchette, qui publie d'abord son: *Emparons-nous de l'industrie* et qui expose ensuite la méthode à suivre dans cette voie dans son *Évolution économique dans la province de Québec*, deux écrits de l'année 1901, dont il reprendra le thème quatre ans plus tard, dans ses *Études sociales et économiques sur le Canada.*

Quoiqu'il ait ensuite versé dans le roman, Bouchette, en qui la Société royale réclame un de ses membres, s'il ne fut pas l'homme d'un livre, fut certainement celui d'une idée, de l'idée que la survivance du Québec était liée à l'exploitation industrielle par ses fils de

ses abondantes ressources naturelles. Mieux servi par les circonstances, mieux préparé par l'étude, cette idée, il sut la mettre en relief et en circulation, avec la foi ardente du néophyte. Sa thèse souleva un intérêt considérable, auquel la prospérité du moment d'une part, et de l'autre, la logique de l'auteur apportaient des confirmations, à première vue, péremptoires. Elle fit certainement époque, car on peut dater de son apparition une orientation nouvelle de l'opinion aussi bien que de l'enseignement. Premiere reconnaissance de ses réclamations, on vit l'université de Montréal inviter chez elle l'économie politique en lui donnant une chaire à la faculté de droit. Mieux encore, le gouvernement Gouin créait de toutes pièces l'enseignement économique, en fondant, cette même année 1907, l'École des Hautes Études commerciales à qui les deux Écoles techniques de Montréal et de Québec viennent aussitôt apporter une coopération complémentaire.

Une ère nouvelle s'ouvre ainsi pour la science économique. Elle possède une chaire dont les techniciens dans leurs cours d'abord, dans leurs écrits ensuite, propagent les disciplines scientifiques et les rattachent aux faits du milieu canadien. Un mouvement se crée, qui s'élargira avec chaque promotion d'élèves, avec chaque conférence, mouvement qui vulgarise à la fois le principe et la technologie et pousse son oeuvre de pénétration dans les classes supérieures d'où lui viendront des auditeurs intéressés et des disciples de bonne volonté. A ce mouvement se rattache la création en 1914 de l'Annuaire statistique de Québec, archives indispensables des études sociales. Autre prolongement de la même initiative, l'*École des Sciences sociales, économiques et politiques* de Montréal ouvre ses portes en 1921. A la même inspiration, revient, en grande partie, le mérite d'avoir orienté vers l'Économique deux institutions, d'un rayonnement considérable, *Les Semaines sociales*, et les *Congrès de l'Association catholique de la Jeunesse*. Enfin, il importe aussi de noter l'apparition en 1925, de l'*Actualité économique*, la progressive revue qui sert d'organe aux anciens de l'École des Hautes Études Commerciales.

Ces développements sont encore trop près de nous pour avoir porté tous leurs fruits. On peut quand même, dès maintenant, constater la bienfaisance et la solidité de leurs résultats. Une littérature économique est en train de se créer, qui dépasse en tous points l'ancienne par la sûreté de sa discipline, la présentation de ses travaux et l'étendue de son champ d'action.

Dès ce moment, on peut signaler des travaux sérieux, qui, colligeant et interprétant les faits par la méthode, forment d'intéressantes contributions à notre bibliothèque scientifique. Voici, par

exemple, le livre de Bouthillier-Chavigny, *Le Canada Économique*, qui inventorie notre outillage économique de la banque aux voies de communication et celui d'Edmond Buron, *Les Richesses du Canada*, qui couvre tout le champ de nos ressources naturelles et de nos institutions financières. Un membre de la Société royale, M. Arthur Saint-Pierre, commence la série de ses publications, où il traite, dans la sphère plus vaste des questions sociales, les problèmes économiques qui relèvent à la fois des deux disciplines. En 1914, il donne *Questions et Oeuvres sociales de chez nous*, et en 1925, *Le Probléme social, Quelques éléments de solution.*

Ici se présente le nom d'un autre membre de la Société royale, M. Édouard Montpetit, qui occupe un rôle special d'animateur dans le domaine des études économiques. Par sa situation, à l'intérieur comme à l'extérieur de l'université de Montréal, il exerce, en rayonnement et en profondeur, moins peut-être par les livres que par la parole, le talent et le prestige, une influence des plus stimulatrices et fructueuses. A la Société royale, il a donné, en 1916, une *Introduction à l'étude de l'Économie politique*, où il met en lumière son importance et son actualité pour le pays de Québec. Tout récemment, dans son dernier livre: *Pour une discipline*, il plaide, avec une rare maîtrise, pour que notre jeunesse et notre élite empruntent à la science économique les directives qui nous aideront à triompher dans le stade actuel de notre évolution, celui des forces matérielles, où s'impose plus qu'ailleurs, l'urgence d'une doctrine.

Un autre sociétaire, M. Georges Pelletier, dont les articles de presse ont scruté déjà plusieurs questions de l'heure, nous a donné quelques brochures, trop rares, d'actualité économique, telles que: *Tout est cher, Pourquoi?* et *Le partage de l'immigration depuis 1900.* Une excellente monographie de M. Eugène Rouillard, encore un membre de notre société, *La Côte du Saint-Laurent*, nous mène à une seconde étude, aussi de mérite, qui la complète en la mettant à date, *Notes sur la Côte nord du Bas Saint-Laurent*, par M. Edgar Rochette. M. l'abbé Caron, qui appartient à la Société royale, nous a donné une brochure fort intéressante sur l'Abbitibi. On peut encore mentionner *Pour rester au pays*, de l'abbé Bilodeau, étude sur l'émigration des Canadiens-français aux États-Unis. Notons pour les points nombreux qui le relient à l'Économique, l'ouvrage de M. Raymond Tanghe, *Géographie humaine de Montréal.* N'oublions pas les substantielles contributions que renferme la dernière publication de l'École des hautes études commerciales: *Études économiques. Thèses présentées à la Licence en Sciences commerciales en mai 1931*,

où se rencontrent des mémoires sur le blé, la politique commerciale, la production maraîchère, etc.

A côté de ces livres et de ces brochures, il s'impose de signaler l'heureuse et féconde initiative des *Semaines sociales*, dont les réunions, outre leur propagande à travers le pays, apportent, sous forme de mémoires, une collaboration nouvelle à l'étude de nos problèmes économiques. Ces mémoires ont ensuite été réunis et mis en volume, sous les titres suivants: *Capital et Travail*, réunion d'Ottawa, en 1922, *La Propriété*, réunion de Sherbrooke, en 1924, et *Problèmes économiques* réunion de Saint-Hyacinthe, en 1928. Sans doute, à ces travaux reçus de différentes mains, il manque parfois ou la méthodologie qui éclaire, ou la pratique qui féconde, mais l'ensemble compose quand même une compilation de faits et d'idées d'une indéniable utilité. Dans le même plan se rangent les congrès de l'Association catholique de la Jeunesse. Les rapports officiels, aujourd'hui en librairie, de ces assises nous offrent une sérieuse documentation, entre autres, sur les sujets suivants: *Le Problème agricole au Canada-français*, congrès de Saint-Hyacinthe, en 1916, *Le Problème de la Colonisation au Canada-français*, congrès de Chicoutimi, en 1919, et le *Problème industriel au Canada-français*, congrès de Québec, en 1921. Utile propagande qui vulgarise l'information et la technologie, il est juste de signaler les bulletins économiques de plusieurs institutions financières.

Il ne relève pas du programme de cette rétrospective d'examiner les ouvrages que les économistes de France ont consacrés au Canada, mais il nous semblerait manquer à un certain sentiment, peut-être subtil, de justice, ainsi qu'à l'impératif bibliographique, en ne mentionnant pas, tout au moins, la précieuse collaboration qui nous est ainsi venue de l'étranger. Il n'est pas question d'énumérer ni les auteurs ni les oeuvres qui commencent avec le *Tableau statistique et politique des deux Canadas* d'Isidore Lebrun en 1833 et qui se continuent jusqu'au livre paru l'an dernier: *Un pays neuf, l'Ouest canadien*, de M. Joseph Wilbois. Mais, le moins qu'on puisse faire, c'est d'indiquer les ouvrages les plus remarqués, tels que *Le Canada* de Ferdinand Van Bruyssel, qui a si peu vieilli quoique de 1895, *La Colombie britannique* d'Albert Métin, l'autorité en la matière, *La Saskatchewan* de Louis Gilbert, et *Le Canada d'aujourd'hui* de Henry et d'Hauterive.

Surtout il reste à inscrire dans cette liste le nom de deux hommes qui, en plus de leurs contributions, ont mis à notre service, à la tête de notre École des Hautes Études, leur compétence et leur dévouement. A l'un, M. de Bray, nous devons l'*Essor industriel et commercial du peuple canadien* et à l'autre, M. Henry Laureys, l'*Essai de géogra-*

phie économique du Canada et son plus récent ouvrage, *La Conquête des marchés extérieurs.*

En résumé, de cette rétrospective d'économie sociale au Canada-français, il semble qu'on puisse conclure que, dans cette sphère, notre production, durant les cinquante dernières années, ne s'avère relativement ni aussi abondante ni aussi marquante que celle que nous offrent, par exemple, l'histoire et la littérature. De fait il semble que la fondation de la Société royale ait coincidé avec un ralenti dans le nombre et l'importance des écrits, ralenti dont nous avons signalé, sinon les causes, du moins les circonstances. Des vingt-cinq premières années du demi-siècle sous étudc, il ne restera que quelques noms dans les répertoires et probablement moins d'ouvrages que l'on consultera dans l'avenir. De cela, il ne faut peut-être pas s'étonner outre mesurc. Si l'on peut s'improviser écrivain et si l'on peut devenir historien, la route se présente beaucoup moins facile au futur économiste. A lui s'impose beaucoup plus impérieusement la néccssité d'une discipline et cette discipline ne se rencontrait pas en notre pays. Il faut aussi se souvenir que l'ambiance n'encourageait guère l'éclosion d'écrits auxquels ne s'intéressait qu'une infime minorité. Heureusement la situation a fait volte-face. Aujourd'hui, c'est-à-dire, depuis vingt-cinq ans, la discipline existc et le milieu se fait de plus en plus sympathique. Le jour de l'économiste se lève cnfin. A juger par les résultats obtenus des noms s'imposent déjà: il suffit de mentionner, entre autres, ceux de MM. Errol Bouchette, Montpetit et Saint-Pierre, tous trois de la Société royale. Si aucun ouvrage ne peut encorc prétendre à la grande éminence, il existe par contre d'excellentes monographies—plusieurs signées par des membres de notre société—dont le mérite retiendra l'attention future. De plus, une jeune école se forme qui sait manier le style et la méthode et se révèle détentrice de promesse ct de talent. Sous le nom de quelques-uns de ses membres ont paru des contributions remarquées. On peut compter sur eux pour mettre la science économique en lumière et en service. Par là c'est plus qu'un espoir qui se réaliserait, ce serait une œuvre-force qui lentement s'édifierait à côté des autres manifestations de la survivance française en Canada.

English Canadian Literature, 1882-1932

By Lorne Pierce, LL.D., F.R.S.C.

Charles G. D. Roberts, in *A History of Canada* (1896), declared that our literature was then only at the beginning. So are we yet. The past fifty years in Canada have witnessed a striking development in national self-consciousness and nationhood. Poets and artists have emerged to supplant European traditions with a native achievement nourished by the Canadian soil. This native art is neither a miracle nor a mystery; we know its beginnings, and we can trace its evolution. It translates and communicates a distinct experience of life—our own. The life and thought of a man's day temper, condition and individualize all that he does. A nation strives in many ways to find adequate expression, but its most natural and familiar outlet is literature. It is for this reason that the literature of a nation becomes one of its proudest assets, one of the most eloquent symbols of separate existence and conscious destiny.

Thomas D'Arcy McGee, in 1867, truly said that Canadian books, such as they were—Haliburton, Garneau, Heavysege, McLachlin and Sangster—seemed "calculated to our own meridian". These first books may look rather insignificant, judged by world standards, yet they possess value for us. While derivative, they are rich in character and high courage, in the robust qualities of the pioneers, elements which have fertilized our literature to this day. Puritan and Loyalist settlers contributed a supple imagination, sturdy individualism, tenacious patriotism, strong moral purpose and healthy mysticism. Out of these rather fierce loyalties of mind and heart sprang a birthright literature.

Tradition reluctantly gave place to experiment, yet the ligature binding both together was still the life and spirit of the frontier. Few and far between are the shining names worthy of remembrance, yet from rectory, pioneer home and Government post came things that were truly Canadian, "calculated to our own meridian". Imitating the prose of Richardson, Scott and Addison, the poetry of Pope, Gray, Goldsmith, Byron and Burns, they wrought with what lay near at hand—landscape and seascape, Indian, explorer and trapper, warrior and pioneer homesteader—building them into poetry, drama, community sketches, novels and tales of wild life. The time was at last

ripe for change. There were ready to hand a growing national tradition, genuine sources of inspiration, a press and an increasingly sympathetic audience.

Oliver Goldsmith, of Halifax, Sangster, Kirby and Mair paved the way in nature verse for the Group of the Sixties, erroneously called the National School. There has never been any School, discipleship, Renaissance or Decadent Interim. It is all a story of beginnings. The lusty essays and reviews of Howe, Stewart, Reade and Goldwin Smith were forerunners of MacMechan, Macphail, Blake, Osler, Grove, Deacon, O'Hagan, McArthur, Edgar and Cappon. The Indian themes of Kidd, Richardson, Harmon, Kane and Mair preceded Pauline Johnson, Lighthall, David Higgins, D. C. Scott, and Marius Barbeau. Stories of the French régime by Adams, Leprohon, Kirby, "Seranus" and Lesperance were followed by Parker, Lighthall, Ralph Connor, Le Rossignol, Thomson and a host of others extending even into the United States. The backwoods settlement sketches of Susanna Moodie, Catherine Parr Traill, Anna Jameson and Mrs. Simcoe were echoed in LeMoine, Blake and MacMechan, and an avalanche of indifferent novels and vignettes. Frances Brooke's *Emily Montague* was the blue-stocking grandparent of *Anne of Green Gables* and the flood of regionalist fiction. Mrs. Traill founded the nature and animal story type of Roberts, Thompson-Seton, McKishnie, Marshall Saunders, Fraser and Heming. Haliburton was the progenitor of DeMille, Drummond, Thomson, Lanigan and Leacock. Every department of our literary activity since 1882 is the direct lineal descendant of those pioneers.

The pioneers built better than they knew, better than we have generally guessed. They were aided by the national movement. Confederation was in the air. The Provinces joined hands from sea to sea; Canada became one. Anglican, Congregational, Methodist and Presbyterian bodies united into Dominion wide communions. The parish outlook gradually gave way. The soaring eloquence of McGee, Howe and Grant was matched by the music of Roberts' "Child of Nations" and Lampman's "Land of Pallas".

Canada remained a frontier nation, socially and spiritually, nevertheless. The Victorian age had deposited its greatest work. The period of candid and intensive inquiry abroad passed almost unnoticed here, amid hectic tree-felling and road making. Darwin reached our shores a ghostly echo, lost in the din of town building. The works of Flaubert, DeMaupassant, Zola, Daudet, Renan and Taine, of Strauss and Mazzini, of Turgenev, Dostoevsky and Tolstoy, all giants and still alive, seem not to have existed for our writers. Great world events knocked at all doors but ours. We were engrossed

in the drama of making land, the poetry of railroads and factories. It was the England of Tennyson, Arnold, Browning, Rossetti and Swinburne, and the New England of Emerson and Longfellow, that Canada knew as it turned into the eighties. Retaining the literary patterns, as well as the general artistic and moral ideals, of the English poets, Canadians betrothed these to distinctly local and national emotions and enterprises. By an interesting coincidence this new development blossomed simultaneously in both English and French literature in Canada.

In Charles G. D. Roberts the young nation found its voice. What Roberts attempted in history, fiction, translation, essay and nature story, was caught up by a host of contemporaries and successors. The Group of the Sixties followed Roberts in his literary models; the music of Keats, Shelley and Arnold rings through the entire group. His generous encouragement of fellow poets, his sponsorship of Carman and Lampman, his special endowment for leadership, his very choice of themes, were a happy augury. Archibald Lampman remarked that Roberts took a "luxurious delight" in splendid landscape. So did they all. Lampman himself was more tender and serene, but in his frequent dream reveries he saw everything in nature crystal clear. Bliss Carman's ecstatic absorption in a world of endless April conjured up phantasies, mysterious effects, sensuous pageants of colour and sound. William Wilfred Campbell, with rarer moments of pure lyric exaltation, pondered on stern moral qualities latent in nature, on austere patterns of conduct. Frederick George Scott blends the beauty of the Laurentians with a passionate quest for spiritual loveliness and certitude. Duncan Campbell Scott most nearly approaches Roberts in fecundity and range, in the diversity and depth of his emotional experience. Nature, music, art and humanity all appear conspicuously in his poetry, short stories, plays and biographical work. No Canadian poet has succeeded so well in capturing humanity. His work is full of the stuff of life, "the old delicious burden of men and women". He stands first among the poets in matching the heroic features of the Canadian scene with corresponding qualities in men and women, their charm as well as their strength. Roberts' sonnets on the work that men do are unmatched in our literature; Scott shows the men at work and in their most human moments. The nearest approach to this preoccupation with humanity in its exalted moods is to be found in the poetry of E. J. Pratt. Frederick George Cameron, inspired by Mazzini, was concerned chiefly with freedom, love and the underdog. Wilson MacDonald is led through nature up to man, only to become doctrinaire, or express himself too vigorously in regard to man's stupidity and cruelty.

Roberts and his group seemed to spring full-armed from the head of Zeus. There was little fumbling and sprawling, but, on the contrary, a sure sense of their craft. Lampman conceived of poetry as a "transformation of life"; Roberts held that poetry *is* life, life without corruption and without decay. All of the Sixties regarded nature as a sufficing power. While Roberts lacks what W. H. Davies calls the "delicate, beautiful and immortal detail", Lampman and Scott have a good deal of it. Roberts achieves his ends with bold strokes, a cosmic vision, rarely found in his contemporaries. Carman was content to be an impressionist, and to sing blithely of Mother April and the Over Lord. Roberts' method may be found in "O Solitary of the Austere Sky", "Immanence", and "Beyond the Tops of Time".

When Carman was studying at Edinburgh, and Roberts was teaching at King's College, they exchanged letters in which they avowed that they had a mission as interpreters of the young nation. The entire group became our spokesmen and interpreters. None of them lived in an artificial world, but it was a narrow world none the less. There is ever present a quenchless thirst for experience, but it ends in a passionate invocation of the solaces of nature. World movements leave them untouched, in spite of Wordsworth's injunction and Arnold's practice. Roberts ranged farthest, perhaps not always to his artistic advantage. Carman lived rapturously in a world of ecstasy. Parker escaped into the more congenial atmosphere of Park Lane, the Mother of Parliaments and cosmopolitanism. Scott had the advantage of travel and a national field for his departmental labours. Yet, on the whole, there is a noticeable lack of content, of range and depth. They also lack a capacity for passion. "Passion", said W. B. Yeats, speaking of Molly O'Neill's acting, "passion, she has not, for that looks beyond mankind and asks no pity, not even of God. It realizes, substantiates, effaces, scorns, governs and is most mighty when it passes from our sight." The pressing weight of the puritan tradition, the moral urgency of rectory and parsonage from which they came, the general Victorian reticence, the standardized etiquette of college class room, parish and government bureau, these were unfriendly toward anything too startlingly original or forthright.

Roberts and Parker never really escaped. Many a fine lyric of Roberts is ruined by the commonplace moral tag at the end. Parker is full of dull evangelism and trite homiletics. Campbell raised Victorian morality into a brand of fanatical imperialism. Carman sang the robust stein songs of Vagabondia, yet, at the same moment, he was composing his poems on the unseen. He contrived an eclectic system out of Emersonian transcendentalism, Delsarte's unitrinian theories, Arnold's "sweetness and light", Spinoza's ethics adulterated

with Royce, and later added the Yoga doctrine of poise and ecstasy together with certain theosophical teachings as shown in "Shamballa". Yet he was a singer by the grace of God. His roots were in nature, and in the same simple faith that nurtured his fellows of the Sixties. The Scotts, Campbell, Lampman, Parker and Pauline Johnson borrowed superficial features of the Darwinian movement, but these were chiefly represented in vague concepts of progress. The same idea later appears in a more pronounced form in Tom MacInnes, Albert Durrant Watson, Annie Charlotte Dalton, Pratt and MacDonald. This was the justification for Lampman's cry, "And so let us address our spirits to the height." That cry is the high clear note of the whole group.

It is, perhaps, not enough to sing with the naïve assurance of Pippa about Progress. The French Canadian at the same moment was deriving strength from the altar. He spoke blithely, yet reverently of religion, of its sustaining power. No such naturalness is to be found in English Canadian literature. It is too often restrained, posed, commonplace and even flippant. There are exalted moments, a cosmic touch in a Roberts sonnet, Carman's "Vestigia", in F. G. Scott and others. As for the moderns perhaps the chief are Mrs. Dalton, MacDonald and Pratt, with Robert Norwood's rhetorical mysticism and A. M. Stephen's theosophical pieces. None has introduced the Nazarene with such compelling loveliness as has Marjorie Pickthall, although Pratt, MacDonald, Mrs. Dalton in her Noëls, and Watson often attain to imposing heights.

The startling freshness, the depth and reach of Isabella Valancy Crawford, have received as little recognition as the unobtrusive perfection of Francis Sherman. The frontier desires little subtlety. More to its taste is the sonorous song of Pauline Johnson, the sentimentality of her poignant laments, and the strident note of her patriotism. More to its liking is the habitant jargon of William Henry Drummond, and the two-fisted heroics of Robert W. Service. Yet, strange to say, Tom MacInnes awaits adequate recognition although he possesses God's plenty of vigour.

Of the recent poets Marjorie Pickthall, within the limits of her restricted experience, has no peer for sheer bewitchment of melody and colour. She too was ambidextrous, turning out novels and short stories in profusion, while at the same time composing our best poetical one-act play and several volumes of verse of unblemished beauty and exquisite spiritual symbolism. Annie Charlotte Dalton stands easily next, a poet of profound spiritual and intellectual grasp, and technical skill of high order. Few books in our literature can match the depth and beauty of *The Amber Riders* and *The Neighing*

North. Phillips Stewart, Gertrude Moffat, Lloyd Roberts, Jean Blewett, Isabel Ecclestone Mackay, Ethelwyn Wetherald, George Herbert Clarke, J. D. Logan, Florence Randal Livesay, Lilian Leveridge, Audrey Alexandra Brown and Constance Lindsay Skinner have won a place in anthologies. Some are poets of one poem, like Theodore Harding Rand's "The Dragon Fly" and John McCrae's "In Flanders Fields"; others, like Norman Gregor Guthrie and Ernest Fewster, will be remembered awhile for their fresh treatment of flowers, their passionate intensity, or their experiments in new forms.

Wilson MacDonald has given us several notable lyrics in *The Song of the Prairie Land*, *Out of the Wilderness* and *A Flagon of Beauty.* His love songs frequently lack the self-forgetful ecstasy of Hood and Herrick; his personal suffering and resentment are too persistently emphasised to be good art. As for his satire and humour, in *Caw-Caw Ballads* and elsewhere, there is often a disappointing element of vindictiveness about it. He might have been our best poet of humanity and social advancement, yet his ideas are not seldom chaotic, his reasoning inconclusive. The fine note begun in *The Miracle Songs of Jesus* should have ripened into a noble poetic commentary upon the spirit of the Nazarene; it has, on the contrary, become weighted with unpleasant admonishment. Yet such perfect things as "Exit" and "In a Clearing" will live. E. J. Pratt, like his mythical sperm whale, is difficult to confine within precise limits. The riotous energy and hilarity of his long objective poems is overwhelming. The terrific tempo of his dramatization, its breathtaking incidence, striking pictorial quality, and amazing rhetorical vocabulary occasionally reach exalted moments, as in *The Titans.* Pratt's best work, however, is to be found in the more restrained *Newfoundland Verse*, parts of the sea epic *The Roosevelt and the Antinoe*, and above all in *The Iron Door.* There is no reason why we should not have in Pratt the long awaited poet who will turn our national epic of character and incident into fine swinging ballads.

Our nature writers, critics, literary biographers and humourists we must pass over. The work of Merrill Denison demands special praise. *The Unheroic North* and *Henry Hudson and Other Plays* entitle him to be recognized as the legitimate founder of our modern drama.

Regarding our novelists and short story writers there is little to say. A scant half dozen novels rise above sea level. Knister's anthology preserves the best of our short stories. They are nearly all regionalist and superficial. In the beginning our story tellers identified themselves with romance. They reflected the unbounded optimism of the expanding fortunes of the nation. William Kirby,

Gilbert Parker, William Douw Lighthall, "Seranus", Ralph Connor, L. M. Montgomery and a multitude of others write in an exuberant mood. The strong are the good and the beautiful; righteousness and the will of God prevail. From Charles G. D. Roberts, Theodore Goodridge Roberts, and Norman Duncan in Acadie and Labrador, through the parishes of *les anciens canadiennes*, over the trails of the conestoga, the Red River cart, and on the prairies in Stringer's homesteads, with Watson's and Cody's frontiersmen, with Stead's grain growers and cow punchers, and Laura Goodman Salverson's Viking brood, to the Pacific coast romances of Bertrand Sinclair and Isabel Ecclestone Mackay, the pageant of the colourful frontier moves on.

The realists followed, reflecting doubt, disillusionment and the universal unrest. Frederick Philip Grove's *Settlers of the Marsh* and *A Search for America* show life clearly but not entire. *The Yoke of Life* is a pale enough copy of *Jude the Obscure*, a tragedy of the unfulfilled artist in man; *Our Daily Bread* is as unreal as *Sussex Gorse* is convincing and beautiful. The note is one of cynical despair; the voice is that of a prophet but the prophecy is wanting. Mazo de la Roche is clever, sprightly and capricious. The details of her later novels are brilliant, but the total effect is disappointing. Communities and men have no deep tap roots, no definite goals. Morley Callaghan's compact style and economy of line seem to promise something clear-cut and conclusive, but his businesslike method ends in no business being done. His characters are dull and uninteresting. After all there is little worth in brutal lumber bosses and calloused rum runners; they are inarticulate because they are pigmy souls and intellects, and have nothing to say. Harvey O'Higgins did better with his Freudian types, but New York absorbed him. Alan Sullivan, Pierre Coalfleet, Frank Parker Day, Raymond Knister, Frederick William Wallace, J. H. McCulloch and others preserve a healthy balance; their frontier types, fishermen, colonists and backwoodsmen, possess nobility of character and stand for something significant. As for the realistic travesties of cowboys, bootleggers, yokels and bromide Mounties nothing can be said. It is likely that this absurd type will continue to go on, and, thank Heaven, go out.

The best of our poetry challenges comparison with the best in the world; our fiction is far below in artistry, ideas and truth to life. It shows the lack of care and discipline. It is satisfied with picturesque aspects of the surface of our frontier life. Compare it with contemporary fiction in Great Britain and the United States, most of it likewise regional, and note the vast gulf. It would seem that the limits had been reached in the present type of nature poetry, and the topical treatments of our varied scene. For long the physical im-

mensity of the country will oppress our writers and artists, yet there are unmistakable signs of new interests, a new depth, detachment, sophistication and ripeness. But the main thing is a finer awareness of life. The palm belongs to him who can go down into the crypt and abyss of a man's soul, and report faithfully what he finds there, who can cause a heart to "beat beneath the ribs of death". It needs the "forthright craftsman's hand", as Andrea del Sarto said, not "low pulsed" as now, but vigorous, disciplined and sensitive.

Fifty Years of Canadian History

By Chester Martin, F.R.S.C.

I.

Fifty years ago the Marquess of Lorne, in addressing the founders of the Royal Society of Canada, predicted a new and vital interest in Canadian history. The developments which I have been asked to trace in English-speaking Canada have so far dwarfed the forecast of 1882 that the sequel seems almost a new creation. The facilities for research in federal and provincial archives, the establishment of chairs of modern history in Canadian universities, the place conceded, however tardily and reluctantly, to Canadian history in the curricula of public schools and universities, are scarcely traceable beyond the lifetime of men now living. In a sense much of the national history of Canada has been wrought as well as written since 1882. Years of jubilee are apt to confirm rather than temper this complacency.

But this would be to ignore the "prodigious era" which produced the Royal Society itself. Much of our boasted progress is to be traced to the momentum of the decade and a half which carried Confederation to the Pacific and bound it together by the first transcontinental railway on British soil.

By 1882 four of the major problems of Canadian history had apparently been solved, and the solution of the fifth, it seemed, was already in sight. The tangled issues of race had passed from the incorrigible bitterness of Durham's *Report* to the happier associations of Confederation and the Royal Society of Canada. Responsible government, the greatest joint achievement of both races in Canada, was already far advanced towards autonomy and nationhood. The original federation of 1867 had been a *tour de force.* By 1871 the new Dominion had reached the Pacific in defiance of the barriers of physical geography. And finally, within a few weeks of the foundation of the Royal Society itself, the Canadian Pacific Railway undertook the herculean task of bringing these scattered communities together. Could this straggling transcontinental British Dominion ever be welded into a nation?

There were still grave doubts fifty years ago how far the federal powers of the *B.N.A.Acts* could function nationally. What if these

scattered communities, having been brought together, were to develop not mutual sympathies, but mutual antipathies, and economic rivalries that could never be harmonized? It would be easy to illustrate these misgivings in 1882: easy also to illustrate their survival. There are still five or six political climates across Canada. Is there even yet a "Canadian" press or a "Canadian" public opinion? How many English-speaking Canadians ever read a French newspaper, or any newspaper at all printed outside their own province? In that sense the greatest assets in Canadian history have not been our vast area and magnificent distances. These have been liabilities, and they will never cease to be so in our time. Have not our greatest assets been the human ingredients of Confederation, the things of the mind, the spirit of the Canadian people? These are the standards by which the aims of the Royal Society of Canada fifty years ago must now be interpreted.

II.

The year before the foundation of the Royal Society of Canada, Sir John Bourinot undertook to trace *The Intellectual Development of the Canadian People.* Twelve years later, as President of the Society, he modestly surveyed *Our Intellectual Strength and Weakness* in terms which have proved in many respects prophetic.

Up to 1882 political life which had commanded upon the whole the best talent and energy of the country had inspired its most distinctive literature. Howe's *Speeches and Public Letters*, Haliburton's writings, Todd's *Parliamentary Government*, published in the year of Confederation, had attracted attention even in Great Britain. By 1882, however, the volumes of Christie's *Lower Canada* (1848-1855), of McMullen's *Canada* (1868), of Murdoch's *Nova Scotia* (1873), and of Campbell's *Nova Scotia* and *Prince Edward Island* (1873 and 1875) were already beginning to pale before the rising splendour of Francis Parkman. *Frontenac*, the *Old Régime in Canada*, and *La Salle* appeared in 1877, 1878 and 1880. Two years later came Dent's *The Last Forty Years.* But "the history of Canada as a whole," wrote Sir John Bourinot, "has yet to be written."

The works of Parkman enriched the first decade and a half of the Royal Society of Canada with the most prolific and vivid writing in Canadian history. *Montcalm and Wolfe* appeared in 1884, the *Jesuits* in 1885, the *Half Century of Conflict* in 1892, and the *Pioneers of France* in 1897. By 1898 the ten volumes of Kingsford (1889-1898), Dent's *Upper Canadian Rebellion* (1885), Bourinot's *Parliamentary*

Procedure and Practice (1892), and a host of shorter treatises and essays had made their appearance. In Houston's *Documents* (1891) by the Librarian of the Ontario Legislature, and Withrow's *Canada*—the first attempt perhaps at a popular pan-Canadian survey—there are signs of a new technique and a broader outlook. Despite the subtle deterioration in the literary quality of the press and perhaps of parliament itself, political literature still held its own. The Royal Society itself made no small contribution to the intellectual life of Canada. "No other country in the world," the President of the Society claimed, without false modesty, in 1893, "can exhibit volumes more creditable on the whole in point of workmanship than those of this society." The *Transactions* went to "every library, society, university, and learned institution of note in the world." Such were the "stately quartos of the Golden Age."

III.

With the new century came far-reaching developments in the technique and systematic study of Canadian history.

The Public Archives at Ottawa have dwarfed every other agency in the collection of historical materials relating to Canada. A decade before the founding of the Royal Society the accumulation of national records was begun in the Archives Branch of the Department of Agriculture. Year after year, from quarters so crowded that display was impossible, the results were chronicled or calendared by Dr. Brymner in the *Reports* of the Archives Branch. In 1906 a new building was completed to "house the Archives [so thought the Minister] for half a century." After being trebled in size it is once again bursting with the accumulated treasures of Canadian history. No monetary estimate could express the value of these records to the nation; they are a monument to the acquisitive and scholarly genius of Dr. Doughty. His name is beatified in the prefaces of more volumes of history than any other name, perhaps, in America. Under his good offices and those of the late Dr. Shortt, and the late Mr. William Smith, the Public Archives became, for a whole generation of young scholars, the clearing-house of Canadian history.

The provincial records of Canada have not fared so well. Those of British Columbia, in value and attractiveness, have long been a model for less fortunate provinces. Quebec has at last an admirable Archives building and museum worthy of the wealth of material there available. Perhaps the most conspicuous example of public spirit and foresight is to be found in the new Archives building in Halifax,

the gift of Mr. William H. Chase. For this and for the new museum at Saint John Mr. Chase and Dr. J. C. Webster will live in the history of the Maritime Provinces. In Ontario the housing of provincial archives has long been inadequate and unworthy of the province. Here too there is soon to be ampler accommodation in new quarters. With adequate integration between federal and provincial archives the public records of Canada will compare favourably with those of older communities.

The place of Canadian history in the schools and universities of Canada has been revolutionized since 1882, but the revolution is far from complete, and some of the difficulties have been accentuated rather than allayed in recent years. Under the *British North America Acts* education is a provincial function and it can scarcely fail to be provincial in its outlook. Few text-books in Canadian history find their way into more than a single province. Perhaps the most disquieting symptom has been the old tradition among students matriculating into Canadian universities that Canadian history is unimportant and dull. In several of the provinces the reverse is conspicuously true. Enthusiasm is apt to be contagious, and enthusiastic teachers adequately trained in Canadian hastory have had little difficulty in demonstrating the value and vital interest of their theme. A growing tendency is discernible to reserve the last impact in history at the various "leaving stages" of public school and university, for the history of our own country. It can scarcely be gainsaid, however, that Canadian history in the public schools of Canada is still dominated by provincialism and regional prejudices. The strongest tendencies towards a national outlook are not to be found in this quarter.

The present position of Canadian history, and indeed of modern history itself, in the curricula of Canadian universities is a comparatively recent development. In 1882, with the exception of Dr. Forrest's chair at Dalhousie (1880), not a single full chair of modern history was to be found in English-speaking Canada. The pioneers were Dr. Colby of McGill (1895), Professor George D. Ferguson ("Professor of English Literature and History" 1870) at Queen's where Professor W. L. Grant took the chair of "Canadian and Colonial History" in 1910, and Sir Daniel Wilson ("Professor of History and English Literature," 1853) succeeded by Professor Wrong (1894) at Toronto. At the University of Western Ontario, and in all four of the provincial universities of Western Canada, history has long had its rightful place. The periodical gatherings of Canadian scholars at Ottawa have done more perhaps than any other agency to national-

ize the historical outlook of Canada, to obliterate provincialisms, and to lay the foundations of Canadian history itself in sound scholarship and research.

These activities in professional scholarship have been paralleled by an imposing array of local societies and associations. Several of these antedate the Royal Society of Canada, notably the Literary and Historical Society of Quebec founded by Lord Dalhousie in 1824, and the Historical Society of Nova Scotia founded in 1879. The Historical and Scientific Society of Manitoba was founded in 1883, the Ontario Historical Society in 1898, and many other societies with published proceedings since that date. The Canadian Historical Association, founded in 1922, largely through the persistent efforts of Mr. Lawrence J. Burpee, tended to remain for many years an adjunct of the Royal Society of Canada. It has now been launched upon an independent career, though it lags far behind its counterpart in the United States. The proceedings have been generously printed by the Public Archives.

IV.

What have been the first-fruits of these growing facilities?

While the best research has undoubtedly appeared in independent studies, Canadian scholars have been brought into association in a number of praiseworthy co-operative enterprises. *Canada and Its Provinces* (ed. Shortt and Doughty, 1914, 23 vols.) was "the Work of One Hundred Associates"; the *Makers of Canada* series (1903), the *Chronicles of Canada* (ed. Wrong and Langton, 1914, 32 volumes) and the recent *Cambridge History of the British Empire*, Volume VI (ed. Kennedy), all represent the work of collective Canadian scholarship. Tendencies towards specialization have developed rapidly. The publication of sources has perhaps outstripped the secondary material in permanent value. Beginning with Houston's *Documents* (1891), half a dozen general collections of primary materials are now available in print. The methodical publication of primary material in Canada, however, has scarcely begun. The most successful attempt perhaps at systematic publication has been the admirable series of volumes—now twenty-one in number—published since 1907 by the Champlain Society.

The most discerning step in the co-ordination of scholarship in Canadian history has probably been the annual *Review of Historical Publications Relating to Canada*, founded by Professor Wrong in 1896 and transformed into the quarterly *Canadian Historical Review* under the editorship of Mr. Stewart Wallace (1919) and Professor George

Brown (1929). Restricted as yet to the field of Canadian history, its articles and reviews have explored the best Canadian scholarship; the representative editorial board with its changing panels represents, in some respects, the most closely co-ordinated effort at the present time in Canadian history.

From the deluge of recent publications even a selective list of representative books would be impossible in this brief and fragmentary survey. Memoirs and political biographies, many of them of great distinction, still outnumber the balanced studies of movements and general tendencies. In the admirable Canadian bibliography in the *Cambridge History of the British Empire* are to be found forty-six octavo pages of nine-point type on the printed materials alone. The vast preponderance of this belongs to the twentieth century. A prophetic forecast of the mass of material in print since 1882 would probably have filled the founders of the Royal Society with astonishment.

V.

In the present transitional stage of Canadian history it would be rash to venture a forecast of the future, though one or two prerequisites may be set down without hazard.

The history of Canada is highly complex. Much of it has been the by-product of larger issues. The prejudices to be dislodged, the prepossessions to be rectified, are apt to appal the student whose only concern is the truth. In that sense systematic research in Canada, like the systematic publication of sources, has scarcely begun. Sir John Bourinot's verdict fifty years ago is still substantially true: "the history of Canada, as a whole, has yet to be written." Insight is the pearl of great price. More significant perhaps than detailed monographs or the accummulation of convincing evidence will be the historical approach, the keener sense of direction and perspective, the broader national outlook.

It is the fashion in some quarters to disparage the so-called research schools in the United States. The "schools" may not as yet have written "great" history; but a Canadian who contemplates the enthusiasm of these young scholars on one side of the boundary and the morass of conventional Canadian history on the other, is apt to reflect upon the revolution which has indubitably taken place before our eyes, during the last decade or two, in the recorded "history" of the United States. How much of this has been due to unrecorded toil in the quarries of lilliputian research? At any rate, the thing has

been done. Nobody will ever again have the hardihood to write the desperate nonsense that used to pass for sober history fifty years ago in the United States.

The immediate task in Canadian history also would seem to be one of scholarship. It makes all the difference in the world, Archbishop Whately used to say, whether we put truth in the first place or in the second; and if written "history" does not reflect the truth, then the better it is the worse it is, however attractively it may be written, for it will take the truth that much longer to overtake it. The industry of young Canadian scholars in research, particularly in the field of economic history, is one of the signs of the times. Queen's University has long had a summer school at Ottawa open not only to Queen's students but to visitors as well. Toronto is attempting to direct much of its graduate work in Canadian history, at the Public Archives during the regular sessions of the University. The next move would seem to be an attempt to develop some sort of *liaison* facilities there for the supervision of research students in economics and history from every university that can be induced to support the project.

The task of Canadian history, however, can never be completed by the technique of "graduate schools." Professional research may discover the truth, and inspire the teacher, and illumine the textbook. But it requires a coal from off the altar to make Canadian history live for the Canadian people. Trevelyan in a moment of exasperation at the mechanics of research once claimed that Sir Walter Scott had done more for British history than all the professional historians. Fortunately for Scott there was never a time when Britain itself was not redolent of history. Can the enthusiasm of Canadian historical scholarship be projected into Canadian fiction, into Canadian letters, into Canadian pictures? The work of Mr. Jefferys, in itself, is an answer to that question. Within four or five decades, wrote Sir John Bourinot in 1893, "Canada will probably have determined her destiny." The resources for Canadian history are already impressive, and those are blind indeed who cannot discern the stirring of a new spirit.

Fifty Years of Archaeology in Canada

By Diamond Jenness, F.R.S.C.

Canadian archaeology is a child of recent years that has not yet reached full stature. The Indian tribes that inhabited the Dominion at the time of its discovery are with us to-day, though in diminished numbers, and the study of their customs and beliefs before they disappeared or became merged with Europeans took precedence over the investigation of their ancient remains. This was but normal, for the stone knives and sherds of pottery that lay in the ground would endure for centuries after their makers had ceased to pursue the swimming moose in their bark canoes or to celebrate with song and dance the erection of a lofty totem-pole.

It was not as though the country were dotted with conspicuous remains. From the Atlantic coast to the Pacific there was nothing comparable with the ruined cities and temples of the Old World, or of Central America and Peru; no pyramids, dolmens or stone circles to intrigue the imagination; no castles or fortifications to capture the traveller's fancy, to arouse speculations on the extraordinary differences in men's lives and a search in the soil for faint clues to their past history. Most of our Indians were wanderers constantly on the move to new hunting grounds, and their lodges of brush, bark and skin seldom stood more than a few weeks in one spot and left few traces after they were dismantled. Agriculture, which ties man down to a permanent home and encourages the growth of village and city life, had reached the St. Lawrence lowlands one or two centuries before Columbus; but the Iroquoian tribes who introduced it were still hunters at heart who looked on the cultivation of the soil as fit only for women. Moreover, their primitive stone tools and ignorance of fertilizers permitted their occupation of a site only as long as its soil remained fruitful and fuel abundant in the immediate vicinity. Consequently they also, like the non-agricultural tribes, built flimsy dwelling-places of poles and bark, and migrated to new homes every fifteen or twenty years. More permanent were the huge log and plank houses of the Pacific coast, situated in bays and estuaries to which vast shoals of salmon returned year after year. During the two or three generations that these houses were tenanted there grew up in front of them rubbish-heaps that varied in length from a few yards to nearly a mile and were filled with the débris of innumerable feasts; but although many of the dwellings had rotted away

before Cook landed in Nootka Sound their remains passed unnoticed for nearly a century, because both they and their rubbish-heaps lay buried beneath scarce penetrable forests of fir and cedar. So throughout the whole of Canada, from north to south and from east to west, the eye of the traveller met nothing more conspicuous than circles of stones that marked old tenting-places, rude stone cairns that generally concealed human burials, and strange figures painted or pecked on the surfaces of cliffs or wave-washed boulders. Only in the territory of the Eskimo, in the extreme north and on the Labrador coast, there were some ruins of small stone huts, roofless, filled with snow from November to June, and solidly anchored to the frozen ground during the other four months of the year.

Archaeology languished, therefore, until the middle of the 19th century, when the discovery that glacial man had left numerous traces of his presence in the Old World reawakened interest in the origin of the American aborigines and stimulated a widespread search for their earlier remains. Sir Daniel Wilson, President of the University of Toronto, sponsored the enquiry in Canada. Although he himself conducted no excavations, he published in the Canadian Journal, between 1854 and 1856, four articles on some archaeological objects that had been unearthed in Ontario. In the same journal, in 1856, Thomas Reynolds described some copper implements and other relics discovered at an Indian burial site near Brockville. Then, in 1860 and 1861, the eminent geologist, Sir J. W. Dawson, contributed two papers to the Canadian Naturalist and Geologist on some aboriginal antiquities found at Montreal; and in his well-known book, "Fossil Men and their Modern Representatives", published in 1888, he compared these Indian relics with the stone age specimens of Europe.

Thus the Canadian Journal, and the Canadian Naturalist and Geologist, have the distinction of being the first journals to lend their pages to Canadian archaeology. Others soon followed in their footsteps—the organs of the Natural History societies of Nova Scotia and New Brunswick, the Manitoba Historical Society, the Canadian Institute, the Canadian Record of Science, and last, but not least, our own Royal Society, which entered the field with a paper called "Notes on the Shuswap People of British Columbia", contributed by one of Canada's greatest scientists and explorers, Dr. George M. Dawson. This paper, incidentally, broke new ground by giving the first important account of an archaeological site west of the Rocky Mountains. In 1886 the establishment of the Ontario Archaeological Museum in Toronto, under the direction of the inde-

fatigable David Boyle, inaugurated an era of more intensive exploration in Ontario. The activities of Boyle, and the contemporary interest of United States scientists in the prehistory of our Indians, gave an impetus to Canadian archaeology that has grown continuously ever since.

Let us follow the progress of investigations in the various provinces and summarize the conclusions we have reached from them to-day. In the first volume of the Proceedings and Transactions of the Nova Scotian Institute of Natural Science, issued at Halifax in 1867, William Gossip published a paper "On the Occurrence of the Kjockkenmoedding on the Shores of Nova Scotia". Volume III of the same journal, published seven years later, contained an article by J. Bernard Gilpin "On the Stone Age in Nova Scotia". Then in 1890 the Rev. George Patterson described in Volume VII the fine collection of specmens he had just presented to Dalhousie University. Harry Piers also contributed an article to Volume VII on his own discoveries, and followed it up with other articles in Volumes IX and XIII. Finally, in 1929, Harlan I. Smith and W. J. Wintemberg published "Some Shell-Heaps in Nova Scotia" (Bulletin No. 47, National Museum of Canada), in which they not only described their own discoveries on the coast in 1913 and 1914, but incorporated all the information obtained by previous investigators.

The first account of any archaeological remains in New Brunswick appeared in Volume IV of the Proceedings of the United States National Museum, when Spencer F. Baird described some aboriginal shell mounds he had examined on the coast. In 1884, in Bulletin III of the Natural History Society of New Brunswick, G. T. Matthews described some specimens he had found in a prehistoric village site at Bocabec, and in Bulletin VI of the same society L. W. Bailey reported on other stone age relics of the province. During recent years Dr. William McIntosh, Director of the St. John's Museum, R. P. Gorham, of Fredericton, and W. J. Wintemberg, of the National Museum of Canada, have investigated a considerable number of archaeological sites, and Dr. McIntosh has published a short article on the local types of stone implements.

On the whole, however, archaeology has yielded a very meagre harvest in these Maritime Provinces. It suggests that they were inhabited by some earlier tribe than the Micmacs and Malecites discovered there in the 16th century; but hitherto it has not succeeded in finding any traces whatever of habitation earlier than about the 11th or 12th century.

It is not possible to list in a single paragraph all the workers in

Quebec and Ontario. From 1886 to the present time numerous writers have contributed important articles to the Annual Archaeological Report of the Ontario Provincial Museum, among them A. F. Hunter, A. F. Chamberlain, Dr. G. E. Laidlaw, Dr. T. W. Beeman, and an honoured Fellow of our Royal Society, Dr. J. H. Coyne. Another Fellow, Dr. W. D. Lighthall, has published in our Transactions, and in the Canadian Antiquarian and Numismatic Journal, several articles on the antiquities around Montreal. But the most active worker has been W. J. Wintemberg, who has excavated no less than six large village sites since 1913, and published a score of papers in various journals.

When Cartier sailed up the St. Lawrence in 1535 Huron and other Iroquoian tribes controlled all the fertile lowland on both sides of the river. Archaeology has shown that these tribes had then occupied the area only two or three centuries, and that they had invaded it from the west, probably in two groups, one working along the north shores of Lakes Erie and Ontario, the other along the south shores. They were responsible for the introduction of agriculture and tobacco into eastern Canada, for the Algonkian tribes who preceded them in south-eastern Ontario neither tilled the soil nor practised smoking. In the New as in the Old World agriculture was the foundation-stone of civilization, but in America it began 3000 years later than in the Mediterranean area, and had not yet spread to its natural bounds. So when Europeans appeared on the scene Canada was in the same position as the British Isles about 2000 B.C. The Iroquoian tribes, bringing agriculture and the rudiments of civilization, were knocking at its gates, but the country as a whole still remained in a state of barbarism.

The mounds of southern Manitoba attracted considerable attention between 1880 and 1890, after certain writers had attributed the similar but larger mounds in the United States to a peculiar, non-Indian race. In 1880 Dr. Schultz opened up a mound in the Lisgar district of Manitoba and described its contents in Volume IX of the Canadian Naturalist and Geologist. Soon afterwards Charles N. Bell, in the Proceedings of the Canadian Institute, Dr. George Bryce, in the Transactions of the Manitoba Historical Society and elsewhere, and Henry Montgomery, in the American Anthropologist, described other mounds that they had investigated in the area south and south-east of Winnipeg. But after 1890 interest in plains' archaeology waned (although Wintemberg made a reconnaissance of Saskatchewan and Alberta in 1925), because the strange race of "Mound-Builders" proved to be a myth, and there was no evidence of any inhabitants

on our prairies other than the Blackfoot, Gros Ventre, Cree and Assiniboine Indians who hunted there in the historic period.

Our knowledge of British Columbia archaeology rests almost entirely on the work of Harlan I. Smith, although C. Hill-Tout has also published some useful articles. Smith began work in this region in 1897, when he was attached to the staff of the American Museum of Natural History in New York; and his reports in Memoirs 2 and 4 of that Museum are still the principal sources of information. In more recent years he has conducted further researches along the same coast for the National Museum of Canada, and in the files of the Museum at Ottawa has assembled exhaustive notes on the archaeology of the entire Dominion except the Arctic. His article on "Kitchen-Middens of the Pacific Coast of Canada", published in the Annual Report of the National Museum for 1927, summarises as follows his conclusions concerning the Pacific Coast:

> "At some time preceding European discovery there was a difference in the culture of the coast and of the interior Indians as there is today; there were slight variations in the coast culture that also parallel present conditions and apparently merge with them; and there was a tribe or tribes of peculiar physical appearance inhabiting a portion of the coast in the old shell-heap days that has not been recognized in the modern population."

Some of the shell-heaps he examined were over four hundred years old. Others may be centuries older, preceding perhaps the Christian era. Their extensive exploration, however, is a work of considerable magnitude that must await a generation with larger funds than our archaeologists possess to-day.

Strangely enough, archaeology has attained greater success in the Arctic and sub-Arctic than in any other part of Canada, although it was not until 1909 that Vilhjalmur Stefansson made the first attempt to excavate an ancient Eskimo village. In this area the principal workers have been D. Jenness of the National Museum, and Drs. Therkel Mathiassen and K. Birket-Smith, members of the Danish Expedition to the Canadian Arctic that was led by Knud Rasmussen. These men have traced back the movements of our Eskimo to the first millenium A.D., while the coordinate researches of Jenness and H. B. Collins in Alaska have opened up vistas into a period at least a thousand years earlier. It would seem that by the first millenium B.C., certain Eskimo tribes had evolved a remarkably

complex culture in the area around the Bering Sea, at a time when their more primitive kinsmen were roaming the inland wastes of northern Canada. In the course of centuries both groups threw off emigrant bands. The Eskimo from the interior of northern Canada pushed out to the coasts of Hudson Bay, the Labrador Peninsula and northern Newfoundland. Those from the Bering Sea moved eastward, and drifted along the shores of northern Canada and the Arctic Archipelago until at last one wave entered Greenland early in the Christian era, while another, turning southward into Hudson Bay and Labrador, swamped the colonists from the interior who had preceded them along those coasts. Then, about the 13th or 14th century, the inland natives sent out another wave that overwhelmed the usurpers, flooded the whole coastline from Coronation Gulf to Labrador, and even advanced to Greenland.

Fifty Years of Statistical Progress

By R. H. Coats, F.R.S.C.

In 1880, when the Royal Society was founded, a beginning had been made in Canadian statistics. The British North America Act had named "Census and Statistics" among the subjects falling under federal jurisdiction. A Dominion Census Act had been passed, and the Census of 1871 had been taken. An Act providing for the regular collection of criminal statistics dates from 1876. The same year saw the setting up of railway statistics—an appreciation of the all-important part of transportation even then in the national economy. Of course there were import and export statistics, published by the Customs Department, which carried forward the similar systems of the colonial regime. Several other Departmental reports contained statistics, or what passed for statistics; the monthly bank statement dates from 1856, and our Insurance records even from 1815. Finally there was the "Year Book and Almanac of Canada, being an Annual Statistical Abstract of the Dominion and a Register of Legislation and of Public Men in British North America," but this was a private publication—liberally supported though it was by official patronage.

Mention of the Census recalls the long and honourable record of Canada in census taking. The first scientific Census of modern times, enumerating the population by name, age, family relationship and occupation, was, as we are fond of boasting, that of New France in 1666; it was repeated fourteen times before the British Conquest. Talon himself, the great Intendant, was chief enumerator in 1666. From the early years of the nineteenth century Censuses had been frequent in Upper and Lower Canada, and in New Brunswick and Nova Scotia as well. The student may find the results in summary form in the Report of the Census of 1871 (Vol. IV) in which Taché, the first Census Commissioner after Confederation, gathered together the more significant data of his predecessors, to speed the new Dominion on its way.

Taché is worthy of special commemorative tribute in these early annals. He began as Secretary of the "Board of Statistics" or Committee of three Ministers under which the Statistical Act of 1848 was administered (an early act provided for the registration of births and deaths and for a decennial Census of the United Provinces). His difficulties led him to indite a report in 1866 to the Hon. D'Arcy

McGee, then Minister of Agriculture and Chairman of his Board, which is a clear and telling recognition of the part which statistics must play in administration.

The decade after the founding of the Royal Society saw a considerable advance in statistics. A "General Statistics Act" had at least adumbrated the conception of an *omnibus* point of view—the view that a national statistic is something more than an agglomeration of administrative records. Under this Act the Statistical Year Book of Canada was instituted in 1886, on an official basis, and from an angle which included all official statistics, Provincial as well as Dominion. The Statistical Year Book definitely superseded the "Year Book and Almanac" previously mentioned, which as its title would indicate, was primarily an almanac and register. The Year Book was an *omnium gatherum* rather than a co-ordinated and homogenous national statistic of the modern type, but under the editorship first of Roper and later of George Johnson it was a notable achievement for its day. The year of its inception saw the taking of a Census of Manitoba and the North-west Territories, midway between the regular decennial Censuses, a system that has continued for the Prairie regions ever since. In 1890, again, the importance of social and economic statistics was emphasized in a "Labour Statistics Act", which had a decidedly far-flung objective, as statistics of mining and manufactures were provided for as well as the wages, employment and other data suggested by its title. A report on this legislation by George Johnson, then chief administrator of the General Statistics Act, distinctly glimpses, if it does not fully develop, the lines which statistical co-ordination should follow.

The Labour Statistics Act unfortunately "died aborning," for with the 'nineties, Canada descended into the trough of depression, and statistics sank with it. A Department of Trade and Commerce was established in 1892, and its main activity for some years was the making over of the annual and monthly Customs statistics on an improved classification basis. Useful as the analysis was, it duplicated functions and expense in a way that took a quarter of a century to eradicate. Only with the new century was the advance resumed. Important ground was broken by the Department of Labour (established in 1900), which set up a series of records previously nonexistent on industrial disputes, wages and hours, cost of living, trade union membership, etc. Hard upon this (1905) followed the placing of the Census Office on a permanent basis. To Hon. Sydney Fisher is due the credit of this important reform. All previous Censuses had been taken by what might be termed a "scratch" organization,

which began without experience and sank leaving no trace about the time it had achieved competence. Yet the Census is undoubtedly the largest of statistical engines, its technique the most elaborate and its uses the most fundamental. From 1905 therefore it became possible to carry on policy from Census to Census in Canada. At the same time the Census Act, the General Statistics Act, and the Criminal Statistics Act, were brought within a single statute. Unfortunately, several fields of statistics were left outside the amalgamation (the number of these was later increased by the institution of branches on mining and forestry statistics) so that unity in statistics was far from being recognized. Unfortunately, too, the Statistical Year Book was reduced in scope to an almost wholly tabular review of Dominion Government official statistics alone, and thus lost its characteristic comprehensiveness. Still, the decade 1900-1910 was one of very considerable advance, though the advance was uneven—the advance of a guerilla or irregular rather than of an organized force.

The modern and present stage of statistical development in Canada dates in fact only from 1912 and the appointment by Sir George Foster of a Departmental Commission to review and report upon the entire statistical situation. It will be appreciated that with statistics still left largely to Departmental initiative and concern, with no one responsible for the avoidance of duplications on the one hand or for omissions on the other, and with Provincial statistics out of the picture, the general situation was far from satisfactory. The Commission indeed found it such in no unmeasured terms. Overlappings abounded, side by side with gaps of a serious nature; there was a general lack of co-ordination; technique was unequal and in spots bad; in fine, "there was apparent in the body of Canadian statistics considered as a whole a lack of coherence and common purpose" that called for remedy without delay. The state is not merely the sum of a number of heterogenous activities; it is a unity, and its statistical data must similarly be conceived as such. The remedy proposed was a Central Statistical Office to undertake the organization of Canadian statistics as a whole—"to co-ordinate the statistics of Canada under a single comprehensive scheme and so to extend them that they may meet the present needs of the country and follow the probable course of its development." A "central thinking office" on the subject of statistics, it summed up, was the final desideratum—and the Commission elaborated the phrase with considerable directness.

Leading up to this conclusion, the report had presented a statement and criticism field by field of the statistics then existing. But this was suggestive rather than constructive; it did not definitely work

out the details or methods of the reforms which it proposed. When, therefore, in due course the office of Dominion Statistician was created for the general carrying out of the new scheme, the first task was to "translate" the Commission's suggestions into a series of hard and fast practical arrangements. This completed in an informal way, an Act establishing the Dominion Bureau of Statistics (the "Statistics Act, 1918") was passed and the existing order was launched. That it succeeded within the ensuing two or three years in bringing into line at least several of the fundamental branches of statistics must be attributed to the untiring administrative interest and ripe scholarship of Sir George Foster whose loss Canada has had so recently to deplore.

Vital statistics may be taken as an example of the problem that had to be solved in at least a score of statistical fields. Vital statistics, or the statistics of births, deaths and marriages, are in Canada under provincial jurisdiction, though they are an integral part of population statistics, which embrace in addition the statistics of migration and the Census. In 1918, nine different Acts governed the registration of births and deaths in Canada, appended to which were nine different statistical schedules, which in turn were collected in nine different degrees of completeness, and which, again, were compiled and published according to nine quite different methods. It was impossible to compare province with province or to erect a Dominion total. Equally impossible was it to relate the birth and death records to the statistics of migration (the second great section of current population measurement), or to collate either of these sections to the Census, the third great division in population statistics representing the static or stock-taking measurement of the people. It was as if a departmental store had not only quite different methods of recording day to day transactions in its several branches, but had none of them in consonance with its annual stock sheet. Moreover, the vexed question of jurisdiction intervened. The solution of the difficulty involved, first, the creation of a model vital statistical act, with the appropriate schedules attached; secondly, the acceptance and passing of this by the provinces; and finally an arrangement for uniform compilation and publication—the whole co-ordinated with the Census and migration statistics. All this, though intricate and knotty in the extreme, was accomplished in an excellent spirit of co-operation, and to-day the statistics of births, deaths and marriages, the basis of the public health work of the country, are uniform throughout Canada (though ten quite independent authorities are engaged on them) and on a mounting level of efficiency. Step by step the same principles of reform have been carried into other fields, until as already

said at least the major aspects of concern to the social and economic advance of the country have been brought under control.

Briefly, the scheme includes the following: For population, the Census, vital statistics and migration have been welded, as just described, into a harmonious whole, the Census being enlarged in certain aspects, but reduced in others with improved organization elsewhere. In social statistics, the statistics of education have been co-ordinated in an annual survey, criminal statistics have been improved and enlarged; and a decennial census of institutions has been inaugurated. Production statistics have been put on a comprehensive annual basis over the entire field—which includes agriculture, the fisheries, forestry, mining, manufacturing, power, and construction. Trade (external), transportation (land and water) and communication statistics have been remodelled. Many aspects of internal trade are now treated—a periodical census of trading establishments is a feature of this division. Labour statistics are comprehensive and uniform; prices and cost of living statistics are on an adequate basis. In public finance, Dominion and provincial finance are co-ordinated, and plans made for municipal finance as well. The Canada Year Book—now a conspectus of the entire social and economic life of the Dominion against the appropriate backgounds—and a "Monthly Review of Business Statistics" illustrate the co-ordinating and "barometric" work of the Bureau at its height. While some fields are more adequately covered than others, and while some still await attack, the system is a far cry from the essentially sporadic and uneven treatment which had previously prevailed.*

The administrative machinery of the Bureau is novel yet extremely common-sense. It has been said that statistics must be under single control—how else can the statistics of different fields be made to fit into each other and form a single "articulated" whole? At the same time every Government Department engaged in a specific field of endeavour must be able to command the statistics essential to its proper functioning; in many cases also it can assist in the collection and interpretation of such statistics. This double interest is met by a regulation under the statistics act which, while bringing all purely

*With regard to the usefulness of such an *omnibus* national statistic from the economic point of view, the Macmillan committee has recently expressed itself as follows: "To put on a more scientific bases our acquaintance with the fundamental facts and trends of our economic life, and to replace empiricism by ordered knowledge, might prove to be the greatest step forward that it lies within our power to take towards raising the economic well-being of our country to the level which the technique of production would allow."—Macmillan Report, paragraph 425, p. 185.

statistical work under the Bureau, defines the latter's obligations to specific departments in a series of orders in council. In the case of the provinces, co-operation is achieved under a separate clause in the Statistics Act permitting the Dominion Statistician to delegate his power to, and exchange data with, provincial officers.

A practical example of the working of this mechanism may be of interest. In, say, mining, agricultural, or forestry statistics, where each province previously acted "on its own", with the corresponding Dominion branch blanketing much of its work,—the whole often characterized by narrowness of viewpoint—we have to-day the following typical arrangement: (*a*) a uniform method and technique arrived at in conference between the Bureau and the Dominion and Provincial Departments concerned; (*b*) the Bureau of Statistics printing and providing the standard forms and schedules used; (*c*) the Provincial government undertaking the collection and visé of the data; (*d*) the Bureau of Statistics compiling the data according to an agreed plan; (*e*) publication of the data on a Dominion wide bases by the Bureau, the Provinces being given their own data for separate publication if they wish; (*f*) the Dominion branches using the Bureau as their statistical agent and obtaining from it such statistical service as they require. Such an organization has four major advantages. (1) It eliminates duplication of work, and is correspondingly economical. (2) It ensures complete uniformity and co-ordination within the sphere of each particular subject. (3) It ensures co-ordination between field and field—for example, in production, between mining, forestry, the fisheries, general manufactures, etc. (4) It secures a clear delimitation between the economic and the technical branches of information. The Bureau of Statistics is directly concerned with the former alone, but from its close association with the technical Departments in the way described (it works with over 80 such branches, Dominion and Provincial) it becomes the repository of a vast fund of general information, subsidiary and interpretive of the statistical data, which is extremely useful by way of index to the general public. Of course in many fields the Bureau works entirely independently.

More and more is such an organization, though primarily for the use of the government, becoming of direct service to the people at large. Not the least noteworthy development in present-century business has been its employment of statistics and statisticians, first for the analysis of its own affairs, and second to keep it in touch with trends and happenings in the economic world at large. Twenty-five years ago the "private" statistician was unknown in Canada.

The final function of the Dominion Bureau of Statistics is that of

a laboratory for social and economic research. On the deductive side of such research we may safely trust to private scholarship and the universities, the results of whose thinking, from Aristotle to Adam Smith, Mill, Marshall and the moderns, are at the disposal of all. But on the inductive side the Government has a unique and positive duty. In the social sciences we cannot isolate phenomena and experiment with such as in the natural sciences; we can only observe, record, analyse and interpret the doings of mankind from day to day; in other words we can only employ statistics, and only the Government has, first, the money, and secondly the inquisitorial powers which statistical work implies.* Whether we regard statistics as a science which embraces the content of its materials, or only as a scientific method by which these materials are collected and interpreted, the organization and procedure necessary to give them their proper range and place is now adequately recognized—and this is the outstanding fact in statistical progress of the last fifty years in Canada.

*Some writer has said, "Every Act of Parliament is a social or economic experiment". But it is the isolation of the circumstances and results of such "experiments" that constitutes the statistical problem.

Fifty Years of Political and Economic Science in Canada

By O. D. Skelton, F.R.S.C.

In Canada, the systematic study of political and economic questions, as a distinct branch of knowledge and inquiry, is almost contemporaneous with the development of the Royal Society. It is a growth of the past fifty years.

Before that time, there was of course much acute and searching discussion of specific political and economic issues in press and parliament. But of systematic and objective analysis of the whole social problem, and particularly of the ways of man in making a living and in making a state, there was little. In the struggle for responsible government, in the controversies between warring creeds and tongues, in the solution of the early tasks of taxation, currency and transportation, and most notably in the handling of the difficulties which found their temporary solution in Confederation, there was statesmanship of a high order, there were practical solutions of enduring value, but there was little attempt to view the problems in the light of the ordered experience of mankind. It is significant that the discussion of the union of the provinces lacked the seeking after fundamental principles which in some measure had characterized the discussion of the union of the states eighty years earlier. Here there was no *Federalist.* Even in the case of the more philosophical advocates or critics of Confederation, Galt, McGee, Dunkin, the discussion rarely strayed from a presentation, powerful and far-seeing it might be, of the practical political or economic advantages or disadvantages of the project. Macdonald and Cartier and Brown did not follow Hamilton and Madison and Jay in their wide survey of historical precedents and their searching analysis of the fundamental bases of political society. They had a wider vision, it is true, than Buckingham and Monck, whom Macdonald charged with acting "as if the British North America Act were a private bill uniting two or three English parishes," but they themselves were drafting an Act, not searching political foundations. They were expanding a going concern, keeping, so far as might be, within the limits of their model, the Constitution of the United Kingdom, and concerned chiefly with the solution of the newer problems of federalism. In any case, the sixties of the nineteenth century were a prosaic and matter of fact period in political thought, in comparison with the fermenting years of the later eighteenth century when the rights of man and the laws of nature formed the staple of men's thoughts.

In the years that followed Confederation parliamentary and press discussion covered a wide range of political and economic issues of broad interest and implications. The relations of Church and State were discussed with power and freedom, particularly in the province of Quebec, where the intellectual influence of Old France was then more marked than in later days. The problem of federalism came first. The struggle between the centripetal and the centrifugal forces, the advocates of a strong national government and the advocates of provincial rights, was sometimes debated on broad lines but more frequently developed into party and personal struggles between a Macdonald and a Mowat. Then came the question of Canada's relation to the Empire. The rising tides of nationalism found expression in the Canada First movement, in Edward Blake's tentative advances, in the growth of industrial protection, and in some measure in the imperial federation movement which had its roots as much in the stirrings of national sentiment as in imperial and Anglo-Saxon pride, and eventually, after the war had precipitated sentiment, in the surging advance which reached high water mark with the passing of the Statute of Westminster. Finally, the question of our adjustment to the world. In these later years, as national responsibility developed, and the world became inconveniently smaller, we have been compelled to take a direct and first-hand interest in international affairs. As to economic issues, they have been dominatingly the transportation problems of a new country and the tariff problems of rising industrialism. Much heat and much ability have gone to their discussion, but relatively little light; we fought for a generation over tariff theories with little inquiry into the actual working of tariff schedules, and over railway projects with little study of the actual need and feasibility.

To turn to more systematic and detached inquiries. The position of economic studies when the Royal Society was young, may most easily be appreciated by turning over the pages of a substantial volume of papers, entitled *Canadian Economics*, presented before the British Association, Economic Science and Statistics Section, at the meeting held in Montreal in 1884. The papers are almost wholly descriptive, accounts of Canadian resources or government departmental practice—the fisheries or the phosphate industry, the post office savings bank, the lighthouse system. Some elementary analysis of land versus water transport, a brief review of the pros and cons of the Canadian branch bank system, and a still briefer but definitely theoretic analysis of harmonies and antagonisms in social forces, showing some beginning of Henry George's influence, are the nearest approach to any independent grappling with economic theory.

Fifty years ago the social sciences had hardly found entrance into academic halls. The fine old disciplines of classics, mathematics and philosophy held the field, though the natural sciences had shouldered their way and modern languages held a minor place. Both politics and economics entered, under the mantle of philosophy, a sound beginning. In the Queen's University calendar of 1878-9, for example, we find John Watson, professor of Logic, Metaphysics and Ethics, including a course for honours in Political Economy based on Adam Smith, Mill, Cairnes, Fawcett and Jevons. Eight years later the name of the Department was changed to "Mental and Moral Philosophy and Political Economy," and the influence and interest of Adam Shortt, then appointed tutor, is shown in the addition of Roscher and Cunningham to the list of authors studied. Three years later, in 1889, work in economic history and economic theory had broadened out, and honour courses in Society and the State, ranging from Plato and Aristotle to Maine and Green, had been added. A notable step in Canadian academic annals was the appointment of W. J. Ashley to the University of Toronto in 1889 as Professor of Political Economy and Constitutional History. F. A. Walker with Laughlin's edition of Mill, provided the basic course in economics, with courses in the history of economic theories, particularly from Smith to Ricardo, and the history of economic development, with Rogers, Ashley, Cunningham and Toynbee the basic texts. The influence of the contemporary renaissance in United States study of economics is shown in the use of Ely, Adams, Seligman, Taussig, in addition to Jevons and Giffen. In political science, the main course was a history and criticism of political theories, ranging from Aristotle to Spencer and Green. Ashley attracted to his courses a brilliant group of students, of whom not a few to-day hold high place in Canadian public life. McGill's distinctive work in economics began with the appointment of Stephen Leacock, whose many-sided qualifications enabled him to build up a vigorous department. In Manitoba, where political economy had earlier been taught as a branch of the philosophy course in the affiliated colleges, a marked advance was made with the appointment of A. B. Clark to a university chair of Political Economy in 1909.

From such beginnings, the study of economics has made its way, slowly in the remaining years of the nineteenth century, rapidly after the turn of the century with the expansion of the country and the increasing urge of its economic problems.

This growth is evidenced in the establishment of economics courses in every university in Canada, in the steady growth in the

relative importance assigned to economics in the curriculum, in the numbers of the faculty and their increasing recruitment from Canadian-trained graduates, and the even greater growth in the numbers of students. The evolution from the shy and barely tolerated beginnings of fifty years ago to the recognized and responsible position of to-day is a notable one.

There has also been a distinct development in the content and tendencies of the courses. Fifty years ago the study of political economy was just emerging from the doldrums. In Great Britain, the great figures of the classical period had been succeeded by complacent and dessicating popularizers, and the tendency to regard economic theory as a completed and perfected achievement, based on a few fundamental deductions rooted in the niggardliness of nature (and of human nature), something merely to be learned and accepted, was strongly marked. The prosperity of the years that followed the triumph of free trade and *laissez faire* gave authority to these easy generalizations. But new life was stirring. The German historical school had stimulated Leslie and Ingram, Thorold Rogers and Cunningham, to a closer study of other ages and other systems of organizing life. The theoretical restatements by Marshall in England and Walker in America and the practice in analysis and refinements given by the vogue of the Austrian school, the challenge to orthodoxy from Marxian and Fabian and Georgian sources, all had echo and influence in Canada. It cannot be said that any substantial new contribution to pure economic theory has yet come out of Canada. It has rather been in economic history and in the study of taxation, of tariffs, of transportation, of trade unions, of agricultural organization and of money and banking, that our most distinctive work has been done. Undoubted progress there has been. The thoroughness and width of training, the firm grip and ease of handling of theory, the value of the independent contributions to knowledge, which characterize Canadian economists of today, present a marked advance beyond the beginnings of a generation ago. There has never been at any earlier stage any group at all approaching the body of young, trained and keen students who are now concentrating their efforts on the unravelling of the economic problems of the day.

A notable development has been the addition of professional training through the establishment of Commerce Courses in McGill, University of Montreal, Queen's and Toronto, and later in Western and Eastern universities. These experiments show a wide divergence in the amount of economics and general arts work required as a basis, the length and breadth of the course, the extent to which the faculty

is distinct from the economics staff, and the degree of business technique included. This development has met a success that has brought its share of embarrassments, but the trend toward higher standards and emphasis on training in fundamentals rather than in specialized technique is marked.

Another feature in the adaptation of economics to the demands of a changing time is the increasing utilization of the services of economists in public service and private research. The Bureau of Statistics, the Tariff Board, and other branches of governmental activity are more and more enlisting the services of economists. Business firms are coming to realize that training in the analysis and appraisement of economic forces is necessary to supplement, though it cannot supplant, the personal qualities and practical experience which in more simple times sufficed for success. Although the movement has not gone so far as in the United States, already the number of economists permanently or occasionally engaged in business and banking service is marked and influential. The movement has been doubly advantageous; it has done something to bring economics down from the clouds and politics up from subterranean regions. Occasionally a question of professional ethics has been raised—how far is the economist working for a government or a business corporation to find his model in the lawyer, accepting and arguing a brief, or in the priest, dedicated to the advancement of an accepted belief? Perhaps in neither; rather is the economist of to-day working out his own standard, his method of objective analysis and fact-finding, his emphasis upon the necessity of theory to light the way through the changing maze of facts and equally upon the necessity of open-mindedness and of making certain that the theory takes account of the facts of the moment and not merely those current when last generation's text book was written.

When we turn to political as distinct from economic science, we find that its development has been less notable. The study of politics receives far less consideration from faculty or students than the study of economics. In some measure this may be due to the less obviously practical trend of the study, its less close relation with the urgent individual and social aspect of the dominating problem of making a living; and in some measure also to the slower progress made in putting the study on an inductive basis. There has, nevertheless, been some notable work done; MacIver's *The Modern State* is undoubtedly one of the most brilliant and stimulating contributions made to political thinking in any country in the present century.

In Canada the approach to the study of politics has been partly

through constitutional history and constitutional law, and partly as an offshoot from philosophical and classical studies. The latter factor prevented the study here from ever becoming as narrowly legalistic or purely descriptive as it once was in the United States. There has been a growing tendency to study functions as well as forms, to examine at first hand into the actual working of democratic institutions rather than to accept intentions for facts, to utilize the results of modern psychology in studying the forces that sway opinion and action, and to seek a closer co-ordination with economics. The growing intensity and speeding up of political changes, the pressing urgency of international co-operation, have brought home the need for re-examination of accepted doctrines, and given new vitality to the whole study of politics.

In conclusion, reference may be made to some recent developments in the organization and expression of the guild of the followers of political and economic science. In a country with so widely scattered a population as Canada's, it is doubly difficult for those interested to keep in touch, sharpen wit against wit, and secure the benefits of massed and organized effort. Channels of publication have gradually been found in the university quarterlies, in the *Canadian Historical Review*, and in the series of economic studies carried on by several of the universities of Canada. Professional contact was long secured chiefly through membership in the American Economic Association and the American Political Science Association, which were always hospitable to Canadian students. The Royal Society has afforded a limited opportunity for membership and publication, not corresponding to the present day importance of the field. Latterly, organizations such as the Canadian Institute of International Affairs, the Institute for the Study of Pacific Relations, the League of Nations Society, and particularly the Canadian Political Science Association—a name used in the broader sense to cover economic as well as political studies—have given effective opportunity for the free exchange of view and the essential formation of public opinion. An era of definite promise is beginning.

Presidential Address—Section III, including an Account of The Progress of Physics in Canada

By A. Norman Shaw, F.R.S.C.

(*Read May 27, 1932*)

On May 25, 1882, Thomas Sterry Hunt, distinguished first president of Section III of the Royal Society of Canada, opened his inaugural address as follows:—

> *"The occasion which brings us together is one which should mark a new departure in the intellectual history of Canada. Science and letters find but few votaries in a country like this, where the best energies of its thinkers are necessarily directed to devising means of subduing the wilderness, opening ways of communication, improving agriculture, building up industries, and establishing upon a proper basis schools in which the youth of the country may be instructed in those arts and professions which are among the first needs of civilized society. The teachers under such conditions can do little more than interpret to their pupils so much of the wisdom of the past, and of contemporary science, as may suffice for the immediate wants of the country, and will have but scanty leisure for original investigation in the field of knowledge. There are, however, never wanting earnest and curious minds who feel an almost irresistible impulse to labour in this field, to enlarge the bounds of thought, and to grapple with the great problems of man and nature. To foster this spirit, to encourage its beginnings and to extend the influence of its example, should be the aim of wise statesmen and legislators who seek to elevate their kind and ennoble their nation: knowing that the brightest glories and the most enduring honours of a country are those which come from its thinkers and its scholars.*
>
> *The world's intellectual workers are, from the very nature of their lives of thought and study, separated in some degree from the mass of mankind. They feel, however, not less than others, the need of human sympathy and co-operation, and out of this need have grown academies and learned societies devoted to the cultivation of letters and of science. The records of these bodies in Florence, in Rome, in Paris, in London, and elsewhere, are the records of scientific progress for the last three centuries. Such*

bodies do not create thinkers and workers, but they give to them a scientific home, a centre of influence, and the means of making known to the world the results of their labours." . . . (They also should become) "a body of councillors, to which the executive authority could always look for advice and direction in scientific matters relating to the interests of the state."

The opening sentence of the inaugural address of 1882 is once again peculiarly appropriate but on quite different grounds. This jubilee occasion coinciding with the opening of these magnificent national laboratories, brings us together from Canadian centres of learning and investigation which are now distributed from the Atlantic to the Pacific, and after fifty years we have reached another stage which should mark a new departure in the history of Canada. We have completed fifty years of apprenticeship in science and letters, and we are ceasing to lean indefinitely on others for our inspiration and our standards.

In matters of education we are finding that our Canadian youth is worthy of a course of training comparable to the best obtainable and that he is also competent to follow it with distinction. We are definitely ready for a new departure in which the standards of our schools and universities should be raised further to a level more in keeping with the high destiny of our people; and we hope to hear no more the voices of those who timidly demur and still tell us after all these years that this is an immature young country, in which our best energies must necessarily be devoted to the careful copying of parent civilizations and to rough frontier pioneering, but apparently not yet to pioneering in educational method and scientific investigation.

We maintain that with but a fraction of the direct support given so lavishly in the past to some of the large pioneering projects of this land, it would be possible from the fields of learning and research to obtain returns immeasurably greater, and without doubt more vital to our ultimate welfare. There is neither paucity of plan, nor dearth of ability to proceed, but public opinion and informed appreciation of the nature of progress are lagging behind. Those in authority hesitate to apply vigorously the accepted belief that it is in the highest interests of the nation to support with its most intensive efforts both the continued strengthening of its intellectual vigour, and the increased application to all its problems, of the resources and the uniquely successful methods of modern science. The record revealed in a review of the activities of the Royal Society of Canada and its members during the past fifty years supports strongly this urgent contention

that Canada is ready for the greatest of its advances, and awaits a new departure in vision and in action, designed specifically to lessen the wide gap existing to-day between available knowledge and its general application to the welfare of mankind.

In the consideration of the progress of science in this country as reflected by the activities of Section III of our Royal Society, it is my duty to deal with Physics. First let us examine the general position of Physics in the world of fifty years ago, and review briefly its marvellous expansion since that time, and then proceed to inquire what parts of this development have been played in Canada, through the activities of our members.

The General Position of Physics in 1882

Fifty years ago the main impetus given to Physics by the general acceptance of the law of conservation of energy had only recently developed in full force; the famous basic experiments of Davy, Joule and Mayer and the resultant expositions of Clausius, Kelvin and Helmholtz had, after a considerable time, only then thoroughly permeated the leading scientific thought of the day. Fourier's Théorie de la Chaleur had been available since 1822, and "its exquisitely original" methods had laid the foundations for the treatment of both thermal and electrical conduction, but this field of work was still to provide many rich harvests. The foundation stones of thermodynamics and kinetic theory of matter were still fresh. The prolific elastic-solid aether had not ceased to bear fruit, for it had not yet been completely superseded by the electromagnetic aether postulated for Clerk Maxwell's revolutionary treatment of radiation, which at that time the majority of physicists were still struggling to understand. Spectroscopy had been developed as a promising subject but was still in its infancy; the confident prophecies of its value made after the discoveries of Kirchoff were still far from fulfilment. The entire range of modern sub-atomic physics and electron theory, with their multitudes of applications, was still absolutely unknown.

The attention and work of scientific men in natural philosophy had, however, been intensely active, and the previous period of fifty years had constituted a hitherto unequalled record of advance in knowledge. The development and applications of "classical" mechanics, geometrical optics, electricity and magnetism in the manner of Faraday, Ohm and Ampere, and the fertile new subjects of kinetic theory and thermodynamics were all being advanced by great leaps and bounds. Increased precision of physical measurements in general, and the development

of the theory and use of numerous electrical and thermal devices and machines, were perhaps the main goals in the majority of physical experiments performed by all but the few who were confining their attention to the most recent advances.

With the advent and impressive successes of Maxwell's work, the idea was spreading that the pursuit of knowledge in these domains was henceforth to be merely a matter of routine in which the resolutions or elaborations of complex details were to provide almost the only remaining obstacles. Never before had there been such a widespread conviction that the main machinery and fundamental principles of inanimate nature were to be available to man, and indeed to be almost completely appreciated within a comparatively short time! This pardonable conceit of the period easily silenced the occasional suggestion of the philosopher that only the very outermost thresholds of knowledge had been entered; indeed, Victorian civilization as a whole tended to regard itself as part of a great and final peak, rather than as a merely transient landmark in the erratic march of mankind towards a far-distant goal of general civilization which still remains undefined and unforeseen.

Advances in Physics Since 1882

During the last fifty years this Olympian confidence of the previous period met with sad disillusionment, but nevertheless the advance of Physics has accelerated in a manner both spectacular and revolutionary. It has been spectacular in the rapidity of development, in the variety of new discoveries, and particularly in the far reaching influence of innumerable applications. Rapid transportation, immediate communication of the spoken word, and many vast mechanical and electrical industries are applications of science which have undoubtedly led to the most profound changes in human activities and interests. With very few roots more than two hundred and fifty years old, and the major growth in the last fifty, most of this forest of applications has sprung directly from seeds of new physical and chemical knowledge.

The advance has been revolutionary in the sense that it has led frequently to unexpected reconsideration of fundamental ruling principles, and recently it has moved towards a new regime in which previously dormant philosophical problems are tending to occupy or at least to share the high position held for many years by experiments and their application.

Although the principles of conservation of energy and of momentum survive we have discarded the older ideas of conservation of

mass and matter. All matter has been found apparently resolvable into but two main entities, the proton and the electron, which are units of positive and negative electricity respectively. These in turn appear likely to be expressible in terms of fields, sometimes they may possibly unite to form neutrons, or under certain conditions annihilate one another dissolving into radiation. By an ingenious union of the principles of Maupertuis and Fermat we are becoming equally reconciled to the undulatory characteristics of apparently corpuscular phenomena, and to the corpuscular characteristics of what had previously been deemed intrinsically continuous and undulatory. The proton and the electron, through studies of their electric and magnetic fields, and an analysis of radiations associated with the variations of their distribution in space and time, seem illusively to suggest that here again we shall find a simple and sufficient foundation for a complete description of the physical universe.

The characteristic discreteness associated for long with matter has become unexpectedly recognizable in quantities such as energy and change. The experimental investigation of action reveals the quantum, $h\nu$, as a unit for all cases of reception and emission of radiation associated with atomic systems or with any degrees of freedom thereof. In quantity of electricity we have the discrete charge, e. The effect of this apparent general atomicity in nature has been to impose fundamental limitations on the interpretation of observations, and philosophical questions concerning the criteria for continuity and discontinuity have found a new experimental bearing. Our faith in the conclusions which are expressed in terms of schematic models or pictures, has been temporarily shaken; and the systematic correlation of observations by methods which are designed to be independent of any preconceived notions about a background of reality, has become one of the chief aims of much recent theory. In addition to the results and problems arising from a study of quantum mechanics, we find also in the principle of relativity and the discovery of its experimental bearings, another branch of work which has also directed our attention to the reformulation of fundamental concepts, and to the general philosophy of the interpretation of a sequence of events.

In the attacks on the problem of the structure of the atom imagined fifty years ago as impregnable, we have seen an unparalleled series of successes. The outermost defences of the atom have yielded to the intricate weapons of modern spectroscopy; with Roentgen rays we may now measure atomic distances, and assail the inner rings of its electronic outposts; while as a result of the study of radioactivity, we

have the means to bombard its innermost citadel, and not only observe but produce the transmutation of an element. The pioneer contributions of Sir Joseph Thomson and his numerous pupils in the study of the electron and the general phenomena of conduction of electricity through gases, stand out as probably the most important group of investigations in modern physics.

Elaborate apparatus has been developed for these and many new resultant studies; and applications have become so numerous that the world is no longer surprised by even the most startling achievements. We have, for example, the mass-spectrograph with which it is possible to weigh atoms, classify them into isotopic groups, and gauge the packing in their nuclei; particularly familiar are the thermionic valve and the photo-electric cell prolific in important practical uses such as radio and television, and responsible for revolutionary technique in many types of electrical and optical work.

Hardly a season passes without the initiation of some branch of work so large in scope or activity that it almost constitutes a new sub-division of physics. Roentgen rays, terrestrial magnetism, atmospheric electricity, the Zeeman Effect, the Stark Effect, the Raman Effect, and low temperature investigations are only samples of many studies which have provided long series of problems for many workers in many lands.

Nor have the old fields been abandoned. In statistical mechanics we find developments which not only correlate the older kinetic theory and thermodynamics with current problems, but greatly enlarge their scope. The progressive development of chemistry as a mathematical science has been accelerated largely as a result of recent advances in physics, and, one after another, fundamental chemical phenomena have become expressible in terms of numerical and spatial relations determined by the new physical procedures. The precision of physical measurement has been advanced in almost every branch, but owing to the glamour of new fields this important type of work has recently received inadequate attention. If speculation and investment in new enterprises rather than the thorough completion of enduring sections of work are practised by too many, we may, in science as in commerce, expect some confusion and delay in further progress.

The industrial applications of physics are continuing incessantly to alter the course of mankind, the ratio of quantity of production to personal effort is being rapidly augmented, and a myriad of robots await a time of wise direction in the interests of all, when far-seeing statesmen will adopt scientific method as the chief instrument of

national policy. We await governments which will devote their major expenditures of effort, time and money in studying and directing the efficient harvesting and even distribution of the knowledge and power which science places at their disposal. Nature has provided enough available power and material to provide every man, woman and child with both a livelihood and the equivalent of many slaves apiece for long ages to come. Scientific men have indisputably demonstrated the availability of this power, and have perfected the means of its use. The world is about to enter a most crucial period, let Canada play her part!

Canadian Contributions to Physics

Let us now inquire what Canada has done, and what capacity she reveals for taking a part in this new world of science. With something worthy in almost every field and with outstanding contributions in several, the record is, so far, highly satisfactory. Confining our attention to physics only, we find the activities of our Fellows well worth reviewing in some detail on this jubilee occasion, and there is good reason to believe that many other branches of learning in Canada are in the same position. The standard literature of physics is found on examination to contain standing references to original investigations performed in Canada, in almost all branches except the recent theoretical developments of statistical mechanics, wave mechanics and relativity. Furthermore, a few important subjects have received much of their development in Canadian laboratories.

The work of three eminent men should receive first and special mention, not only because of the exceptional value of their contributions but also because they attracted a group of pupils and co-workers who subsequently spread their methods and their enthusiasm for discovery throughout our laboratories. It can safely be asserted that at least three-quarters of our best contributions have come either from these three men and their collaborators, or from those who obtained early training at their hands and followed closely in their paths of investigation. All physicists will recognize this tribute to H. L. Callendar, E. Rutherford, and J. C. McLennan, named in the order in which they commenced their leading activities.

Sir William Macdonald, one of education's greatest benefactors, founded, along with many other endowments, a chair of physics at McGill University, which was to be devoted to research; this example of generosity and foresight illustrates clearly the supreme value of investment in learning and investigation. H. L. Callendar came to

Canada in 1893, as the first holder of this special chair, and almost immediately initiated a series of investigations in heat and in electrical measurements which still continue to bear fruit. The completion here of his work on electrical thermometry and its adaptation to many industrial uses, involving also his widely used compensated bridge and automatic recorder, was accompanied by his initiation of a comprehensive programme of absolute measurements. His equation of state for an imperfect gas, and his famous studies of the properties of steam had their inception in work which he commenced before leaving Canada in 1898. The development of continuous flow calorimetry and its application in the classic determination of the mechanical equivalent of heat by Callendar and Barnes, are among the most enduring contributions of this period. Under his influence, H. T. Barnes was attracted into similar fields, and in 1902 completed what is still the leading investigation on the specific heat of water. Specializing in the study of ice and in microthermometry, Barnes soon obtained an international reputation in these subjects, and later in spite of ill-health for several years, has made numerous contributions and developed almost single-handed the technique of ice-engineering. Space does not permit reference to all the various investigations which have arisen under the influence of these researches. Any merit that may be attached, for example, to the work of the present writer on the absolute measurement of the volt, the maintenance of a standard of voltage, and hygrometrical investigations, may be traced largely to the influence of Callendar and Barnes.

Succeeding Callendar came Rutherford. Undoubtedly Lord Rutherford, among his many records of high achievement, may claim sole responsibility for the greatest outburst of original research in physics yet seen in Canada. He brought with him to this country all the lore of the new sub-atomic physics, fresh from the Cavendish, the laboratory of Sir Joseph Thomson whom he was destined later to succeed. A master of the technique for the study of ionization in all its phases, Rutherford soon attracted a group of investigators which, although small, included men from such distant parts as England, the United States, France, Germany, and Poland.

The theory of radioactive disintegration was formulated and established at this time by Rutherford and Soddy. With the aid of enthusiastic assistants, Rutherford investigated with surprising rapidity, the properties of radium emanation, the ratio of the charge to the mass for alpha particles, the first example of spontaneous transmutation, and a number of problems on the active deposit which led

to the discovery of radium A, B, C, D, and E. With Miss H. Brooks (Mrs. F. Pitcher), he first detected the recoil atoms when alpha rays are emitted, and with her also studied alpha ray absorption, decay of excited activity, and other phenomena; with the aid of Owens and Soddy, Thorium emanation and Thorium X were first investigated, and Soddy commenced the well known work on the chemistry of the radioactive elements. Among our present members, Eve, Barnes, Bronson, McIntosh, Boyle, McLung, each made lasting contributions in these fields about that time.

Among these the earlier contributions of A. S. Eve are conspicuous; his experiments received tweny-six references in one of the standard treatises on radioactivity and included pioneer work on the excitation of β rays by γ rays, on the amount of radium emanation in the air, on secondary (scattered) radiations, and on several problems in atmospheric ionization. Barnes collaborated with Rutherford in the first measurements on the heating effect of α, β and γ rays. H. L. Bronson's radioactive resistance is familiar to all, and nine of his contributions receive reference in the literature of this subject. R. W. Boyle made valuable contributions in the study of the condensation of radium and thorium emanations, while R. K. McClung's measurements of coefficients of recombination of ions still stand in physical tables.

A number of experiments of lasting value were performed by those who gathered from distant parts to learn about this new field, and were later to carry home the seeds for further work; the names Hahn, Levin, Godlewski, and Rumelin will be recalled in this connection. Many seeds were sown during this most active period, and a most important one was the commencement of a series of pilgrimages by Canadian research students to the Cavendish laboratory, the Mecca for inspiration in these and many other new fields. Through the inestimable aid of scholarships, these pilgrimages continue and have maintained a valuable close contact for years between many Canadian physicists and the Cavendish laboratory at Cambridge.

The third member of our leading three, J. C. McLennan, who also had Cavendish experience under Sir Joseph Thomson, is a Canadian by birth, and apart from the war period, he has, up to the time of his recent retirement from Toronto University, performed almost all of his many contributions at that centre. Section III of our Royal Society will greatly miss his regular presence and energetic personality at its meetings. His lucid expositions of ever increasing batches of papers

at each annual meeting, have come to be one of the best features of our gatherings. With indomitable activity he has developed a splendid laboratory, and with the aid of collaborators and assistants, has performed whole series of investigations. In speed of execution, breadth of conception and high value of results, many of these investigations have excited the marked admiration of physicists the world over. Not only has he possessed a remarkable knack of recognizing at once a promising field, and immediately tackling it with superior apparatus, but also he has adorned his numerous extensions of difficult investigations with many fundamental contributions of importance.

It is opportune at this time of special interest in cosmic rays, to recall that the pioneer work on "penetrating radiation" was done by McLennan and Burton, (and also independently by Rutherford and Cooke) as far back as 1901-03, when the first proofs of the existence of a new penetrating radiation were established. McLennan's elucidation of the auroral green line, and his application of the Raman effect in the investigation of ortho- and para-hydrogen are among the best of his recent fundamental contributions. After a long period of successful measurements in various branches of spectroscopy, he has developed an equally promising attack on low temperature phenomena which has led to particularly interesting results on superconductivity. The spreading over the country of a fine training in technique, through the subsequent activities of his pupils and assistants will be an outcome with a high value difficult to assess, but certain to play an important part in future Canadian experiments.

Turning to original work of a totally different character, we note the lengthy series of successful investigations by F. Allen at Winnipeg, in which biophysical studies concerning the mechanism of sense perceptions have given new information and ideas to the domain of physiology. It is probable in the near future that borderline subjects such as this will be of increasing importance, and more physicists should be attracted to them. Of biophysical applications which have immediately improved the welfare of man, the use of X-rays as an aid to surgery, diagnosis, and treatment of disease is one of the greatest; it is therefore of particular interest to recall that the late John Cox, one of our former presidents, took part in the first application made on this continent or in the British Empire, when on February 7, 1896, Roentgen rays were used in finding a bullet in a man's leg. He it was, too, who by the wise direction of his Depart-

ment at McGill University and by his scholarly advice, greatly facilitated the fruition of the work of Callendar and Rutherford in Canada.

Colloid physics is another important borderline subject which has opened rich new avenues of research. In E. F. Burton we have a prominent investigator who has become the leading authority in this field.

Contributions in mathematical or purely theoretical physics have been made by only a few Canadians, but in compensation we have numerous masterly papers from L. V. King, by far the most outstanding Canadian in this field, and also an experimentalist of note. His versatility is illustrated by his widely quoted papers on the scattering of light, acoustic efficiency, hot-wire anemometry, electrodynamics, and the calculation of elliptic integrals and functions.

In J. A. Gray at Queen's University we have the leading exponent of filter and target methods in X-ray technique, an authority on the scattering and absorption of X and γ rays, and the discoverer of change in frequency by scattering, which is the important fundamental phenomenon now known as the Compton effect. Preceding Gray as research professor in physics at Queen's, A. L. Hughes did a portion of his well-known work on photo-electric phenomena while an active member of this society. The development and broad scope of physical research in the same laboratory is illustrated by recalling the work of A. L. Clark on the equation of state, and that of J. K. Robertson on optics, and the electrodeless discharge.

Much attention has been attracted to the excellent batch of papers which have proceeded steadily in the last few years from J. S. Foster and his pupils, dealing mainly with studies of the Stark Effect. Improvements in difficult technique, new experiments with crossed magnetic and electric fields, and the provision of crucial tests for new theoretical points, have placed his investigations in the front ranks of this subject.

It should not be forgotten that the distinguished physicist, H. A. Wilson, now in the United States, was once president of this section. Some of his work on flame conductivity, thermionics and optics was completed while he was in Canada, and he was a source of inspiration to many Canadian students.

R. W. Boyle, the director of physics in the laboratories of the National Research Council, has been mentioned in regard to radioactivity, but as a result of problems arising in war researches he has latterly specialized on experimental ultrasonics with conspicuous

success in spite of arduous duties as a Dean in the University of Alberta. In his present important duties at the N.R.L., the physicists of this section will wish him every success, and can assure him of active support and co-operation in the future.

Eve, Keys and Gilchrist have recently made valuable new contributions in the subject of geophysics as applied to the search for minerals, a matter of importance to mining engineers, geologists and commercial interests. The recent book on this subject by Eve and Keys has been described as the best introduction to this field and has already run to a second edition. The applications of the cathode-ray oscillograph and of the piezo-electric properties of crystals are rapidly increasing, and each of these topics has received advancement at the hands of D. A. Keys.

The reputation of J. Satterly for his laboratory courses at Toronto is unique, and all of us are familiar with his radioactive surveys, and recent attention to complicated surface tension phenomena. H. A. MacTaggart's meticulous work on the electric charges at gas-liquid interfaces is another example of interesting and difficult experimentation. H. F. Dawes at McMaster University has made contributions on ionization by collision, and in optics.

At Dalhousie University, under the principalship of our former president, Stanley MacKenzie, science and physics have been placed in a strong position. With H. L. Bronson already mentioned in regard to numerous contributions in radioactivity, we find G. H. Henderson, also well known for results in radioactivity, thermal conductivity and other topics.

From the west we are welcoming E. L. Harrington from Saskatoon to our membership this year, and note with interest the rapid development of research, and research training in the laboratory of which he is head. Numerous improvements in methods of measurement, studies in the use of radon, and an important determination of the viscosity of air are included in his scientific work. The latter piece of work in collaboration with L. Gilchrist and I. M. Rapp was one of the essential auxiliary investigations for the famous standard measurement of e by Millikan in the United States.

At Edmonton there are the progressive laboratories which were developed under the presidency of H. M. Tory, whose numerous and outstanding services to science in Canada will receive special and separate reference again. Some of the work of R. W. Boyle, who directed that department of physics until recently, has been mentioned,

and we find there, also, two more very active Fellows, S. Smith and R. J. Lang, each with a number of good contributions in spectroscopy and other subjects.

In our indispensable secretary and honorary editor, John Patterson, now head of the meteorological service of Canada, we have an active supporter of the policy of making meteorology an exact science. His many improvements in the physical apparatus used for meteorological observations are well known, including, for example, a highly efficient anemometer, and some particularly ingenious methods for making various observations at high altitudes with the aid of balloons. It is probable that meteorology, in general, is about to burst into a period of greater scientific development than ever before, and it is to be hoped that our meteorological service will be supported strongly in its plans, and in a manner commensurate with the unique opportunities which Canada presents for this field. It must not be forgotten that the high standard of this department and its development into an efficient bureau of weather forecasting was obtained under the leadership of Sir Frederick Stupart, former president of this section, and to whom the country owes a tribute for organizing services of untold value to navigation and to agriculture.

In the domains of mathematics, chemistry and astronomy (including astrophysics), which are to be reviewed in other articles, and also in engineering, there are to be found many contributions of a physical character too numerous to add to our already lengthy list. In their engineering and allied activities, men such as McLeod, Hertz, Goodwin, Stansfield, and particularly the eminent Sandford Fleming, have played important rôles in Canadian industrial and commercial development. The scholarly and thorough work of Bell Dawson, for many years superintendent of Tidal Surveys for Canada, has rendered inestimable benefits to navigation in our waters.

The scientific activities of our Fellows in the Great War will be recalled with pride. McLennan's work as leading scientific adviser and director under the British Admiralty, and that of Eve as director of the Anti-Submarine station at Harwich, were most conspicuous. Gray's work at the Front on the detection of guns by sound ranging, that of Boyle and MacTaggart on methods of submarine detection, and Key's investigations of mine explosions and their pressure-time characteristics, were of particular value in that time of stress and danger. Tory's direction of the Khaki University activities will also be remembered gratefully by many.

Further reference is due to the work of H. M. Tory, our distinguished host, who has invited us so happily to hold this anniversary in conjunction with the opening ceremonies for this magnificent institution. In the educational and scientific activities of the Province of Alberta, in the policies of the National Research Council of Canada, and in the development of these impressive laboratories, he has contributed more than any other individual. An appreciable part of our recent scientific development and improved conditions of training must be regarded as a direct consequence of his organizing ability, foresight and energy.

In enumerating this array of Canadian contributions, some early investigations of note may have been omitted through the ignorance of the writer, but it should never be forgotten that in the first years of our Royal Society, there were a number of exceptionally gifted men who did not have our opportunities for research. Handicapped by lack of facilities and assistance, overburdened with many duties, yet they paved the way for subsequent growth by the inspiration and high standard of their teaching, and by their active support of the aims of this Society. Notable among these was Alexander Johnson who, while a Dean of Arts, a Professor of both Mathematics and Natural Philosophy, personally improvising most of his apparatus for teaching and experiment, yet found time and energy to press continually and successfully for a higher development of scientific life, and to write mathematical and astronomical articles for our transactions. J. K. MacGregor was another, who in Dalhousie fostered the highest traditions of scholarship and set an example in investigation with numerous able experiments on electrolytic phenomena. President Loudon was probably the most outstanding in this group, for in a large measure he rendered possible by his early work, by his vision, and by his support, the subsequent rapid progress of physics in Toronto.

This section has been fortunate in the distinguished character of those of its members who have, from time to time, been elected Presidents of the Royal Society as a whole. The last of these is A. S. Eve, to whom further reference is due, as one playing a leading part in Canadian scientific work. In addition to the contributions in radioactivity, geophysics and war services already mentioned, he has, by his sage counsel, enriched the plans for many activities. Pressing always for high standards, and recognizing merit in plan or person as an essential criterion, he has earned a unique reputation for that beloved

type of modest and unselfish leadership which seeks to promote on every hand a fair distribution of opportunity, training, responsibility and achievement.

It has seemed to the writer appropriate to dwell at length on the achievements and general evidence of the competence of Canadian physicists of the Royal Society, to prove the contention that we are qualified to proceed beyond our apprenticeship, and also to provide a record of the general position to-day, which may conceivably be of interest historically.

McGill University,
March 21, 1932.

The Royal Society of Canada and Canadian Mathematics

By J. C. Fields, F.R.S.C.

The primary object of the Royal Society of Canada, so far at least as its scientific sections are concerned, is to foster the spirit of research in our midst. Through election to one or other of these sections it publicly recognizes services rendered to science and in other ways it emphasizes such services. Through its annual meetings too it brings together from all parts of the Dominion men in diverse branches of science imbued alike by a common interest in research, and in the individual sections it gives more intimate contact to men who have allied scientific interests and affords occasion to them to present their various problems and benefit by comments and discussion on the part of their colleagues. While all the research work done by Canadian scientists is not presented in one or other of the scientific sections of the Royal Society of Canada and while a certain portion of it appears in journals published beyond our borders, nevertheless the programmes of these sections, and the papers published in the Transactions throw considerable light on research conditions in Canada, and in particular on the position of research in our universities.

In the case of mathematics Fellows of this society are responsible for practically all the research work done in Canada if we except only a few of the younger members of our university staffs who in their turn may look forward to being elected Fellows. It would be invidious to single out names for special mention but it may be said, that we are indebted to Fellows of Section III for contributions among others to the Theory of Numbers, to the general Theory of Functions, and in particular to the Theory of the Algebraic Functions, to the Elliptic Functions, and to Bessel Functions, to Geometry, and more especially to Differential Geometry, to the Theory of Integral Equations, to the Theory of Equations, and on the applied side to Mathematical Physics and Mathematical Astronomy. Among the contributions referred to are several recognized treatises.

In giving due credit to Fellows of Section III for their contributions to mathematical science one is constrained to make some comment on mathematical conditions in Canada as a whole. That one of the four corners of the Section should all but suffice to accommodate the mathematically productive portion of our population indicates a position of affairs which is far from satisfactory. In the republic to the south of us the society which corresponds to our

Royal Society counts among its members, as we know, some of the most distinguished mathematicians in the country. They are, however, only representatives of a much larger fraternity whose total output includes vastly more than the contributions of this limited number of representatives.

The initial conditions affecting mathematics have been much the same with us and with our neighbours to the south. In both countries the universities have been handicapped by the defective mathematical training given in the secondary schools. It is generally admitted that as regards mathematics our secondary schools are behind those of the leading countries on the other side of the Atlantic. In fact, it is commonly said, in the case at least of the brighter mathematical students in these countries, that they are two years in advance of the corresponding students with us when at the end of their teens they leave school for the university. In this connection I might say that I am assured on the best of authority that the secondary schools of Ontario pay less attention to mathematics now than they did a generation ago.

Another handicap which Canadian universities have shared in common with American universities is that involved in defective mathematical texts, more particularly texts on the calculus, a handicap not confined to America, but more aggravated on this continent than on the other side of the Atlantic. Some years ago I had occasion to call on a European mathematician and finding that he made a hobby of collecting mathematical textbooks of the character here in question I promptly added to his collection a treatise on the calculus which has had a considerable vogue in the English-speaking world, a work of which an English mathematician has said it left the student in a fog. One would not be far wrong in attributing the near sterility of mathematicians on this continent in the last generation to the teaching of the calculus. All this, however, has been changed in recent times, at least in the leading universities of America, although in some of the smaller institutions one still finds listed textbooks on the calculus which are a relic of the past.

While in the beginning Canadian universities had no greater difficulties to contend with than universities south of the line, the American universities were first in the field with graduate work. Through intensive graduate courses, and emphasis laid on research they sought to make good the deficiencies due to earlier faulty training. This in particular was the case with mathematics. Why our own universities have not in this subject kept even front with those of our neighbours south of the line I shall not here attempt to explain,

nor shall I try more precisely at the moment to indicate factors local or other, whose effect has been to retard realizing on the mathematical research potentialities of Canadians. Whatever those factors may be the Royal Society of Canada cannot be indifferent to any influences which bear on the progress or retardation of scientific research in Canada, for she represents in a very special sense the interests of research throughout the Dominion.

Comparing ourselves with ourselves, one might note that progress along mathematical lines has not been as satisfactory as that in physics—though we had fairly strenuous undergraduate courses in mathematics in our universities at a time when there were no organized courses in physics. This, too, is not sufficiently explained by saying that the number of students capable of establishing initiative along mathematical lines is smaller than the number who can do satisfactory work in physics under proper direction. In this connection I might say that some years ago a member of the staff of one of the leading universities in the United States told me that the strongest research department in his institution was that of mathematics. The man in question, I may say, was not a member of the mathematical staff.

We all know that the inspiration for physics in Canada, as throughout the Empire, finds its origin in the Cavendish Laboratory at Cambridge. Pure mathematics in Great Britain have not thriven as well as physics. We have, however, imported a mathematician or two from the Motherland with advantage. Our mathematical contacts are, for the most part, with the United States, and often enough, or perhaps too often, our students of mathematics take their doctorates in philosophy in the Republic to the south of us. In that Republic the stimulus to mathematical research, the reform in the teaching of the calculus have come from Germany. For many years American students of mathematics visited Germany in search of inspiration for their subject, and there they found it. Returning to their native land they breathed new life into the teaching of mathematics in its universities, and through their accumulating efforts inaugurated a movement which is exerting an ever increasing pressure on the facilities for publication of research work in mathematics. In this movement we Canadians have not participated to an extent proportioned to the expectations which might have been formed for us at a time when our leading universities were on a par with the best of the universities south of the line, before these latter began to develop graduate courses and lay stress on research work.

We have referred to the influence of Germany on the destinies

of mathematics in the United States. It was the prestige attaching to the research achievements of mathematicians in Germany which attracted American students of mathematics to its universities. The success of the German university is due to the fact that it is conceived primarily as a research institution. Research and distinguished research at that, is a *sine qua non* for appointment to any position on its academic staff. The quality most valued in any student too, is that which promises success in research. Not many universities in Canada are in a position to develop elaborate courses of graduate studies, yet it would seem worth while even in the smaller institutions in making major appointments to take into account research achievement and ability to stimulate interest in scientific research in the more gifted students. This applies, of course, to all branches of science, though I fancy it is more likely to be overlooked in mathematics than elsewhere. In the case of appointments in larger universities in which graduate work is more fully developed, the research qualification should be still more strongly emphasized. It would seem axiomatic that the direction of research in any department of a university should be under a research man. The day has gone by when it can be said, as it was said to me some years ago by a prominent member of the mathematical staff of a Canadian university, that it is not a function of a university to train men for research.

Our Canadian universities in common with those of the United States share certain weaknesses in the matter of appointments which are largely obviated on the other side of the Atlantic. There is no standard for the professoriate. There is no body of experts bearing responsibility before the public and in the eyes of their colleagues for recommendations made in connection with a given appointment. There is nothing corresponding to the system of electors which holds in connection with certain of the British universities, and there are no committees such as those which in Europe in one form or another accept responsibility. The detriment in this respect is perhaps more accentuated in mathematics than in other branches of science. Because of the elusive character of their occupation and achievements the reputations attaching to mathematicians in the public eye are apt to be more irrelevant, and less reliable than those obtaining in other branches.

An institution such as the Royal Society of Canada can do much towards eliminating the uncertainty, for with sufficiently exacting conditions of admittance, Fellowship in the Society should in itself furnish a voucher for the scientific standing of a man. In this con-

nection a forward step was taken by Section III when some years back a nomination Committee was appointed in replacement of the former method of electing Fellows by a haphazard ballot.

One might ask with reference to Section III, and more particularly in regard to mathematics, as this article is supposed primarily to concern itself with that science, whether the accumulated wisdom of the Section, under some guise, might not be made available to universities or colleges seeking advice with regard to appointments? Another service which might be rendered would be in supplying information with regard to texts, for in mathematics at least, as we have already noted, textbooks are not all reliable.

In August, 1924, the International Mathematical Congress met in Toronto. Delegates were present from many different countries and the effect of the meeting was to bring Canada into the scientific limelight throughout the world. The fact, too, that the Press of the University of Toronto was able to handle such a difficult typographical task as that involved in the printing of the Proceedings of the Congress was somewhat of a surprise to foreign mathematicians. The Proceedings, we may note, contain several contributions from Canadian mathematicians.

While the Congress doubtless stimulated interest in mathematics to some extent among ourselves the country which benefitted most was the United States. It made new contacts for the American mathematicians, and these have had their results in subsequent visits of European mathematicians to the United States, the visiting lecturers in some cases locating permanently in American universities.

It seems to be becoming the vogue between International Mathematical Congresses to hold National Mathematical Congresses. Last September there was a Roumanian Mathematical Congress in Bucharest. Shortly before there was a Congress of Polish mathematicians held in Warsaw. From time to time the people of northern Europe hold a Scandinavian Mathematical Congress. Some four years ago I was present at the opening of a Congress of German mathematicians held in Prague with an attendance approximating five hundred. When shall we in Canada be in a position to provide programme for a Canadian Mathematical Congress?

Among other evidences of post-war mathematical activity in Continental Europe is the increased pressure on the means of research publication. A like pressure, already referred to, is showing itself in the United States. Since the war some thirty-two mathematical journals have been founded in different countries. Would it not be possible for us Canadians to get into the swim and found a Canadian

journal of mathematics, or perhaps a journal devoted to Mathematics and Physics? Though a Canadian Mathematical Congress is out of the question for some time to come, it is a thoroughly practicable proposition, given the necessary financial backing, to start a Canadian journal of the character suggested. Such journals in general accept foreign contributions. The American Journal of Mathematics founded by the Johns Hopkins University received overseas collaboration from the beginning. The writer might say that European mathematicians have enquired of him whether there was an organ for the publication of papers on mathematics in Canada, at the same time expressing their willingness to collaborate through the contribution of articles. Is the time not near when we should make a start?

Though progress in mathematics in Canada up to the present has not been all that might have been hoped for, things look more promising for the future. There is a small but increasing group of the younger men who are interested in mathematical research, and some of the later appointments have been encouraging.

It is for the Royal Society of Canada in the ways at her disposal to take cognizance of any progressive movement along scientific lines in Canada and to see that prestige attaches to research achievement whether in mathematics or in any other scientific department

Chemistry and The Royal Society of Canada

By F. M. G. Johnson ,F.R.S.C.

The Royal Society of Canada presents in its Proceedings probably the best available record of Canadian achievements in chemistry during the past fifty years.

That this period constitutes a half century of remarkable progress, particularly in science, cannot be doubted. Conditions as they existed at the time this Society was organized were ably portrayed by its first President, Dr. J. W. Dawson, later Sir William Dawson, in his Presidential Address, at its first meeting in 1882:

> "We are sometimes told that the enterprise in which we are engaged is premature, that, like some tender plant too early exposed to the frost of our Canadian spring, it will be nipped and perish. But we must remember that in a country situated as this is nearly everything is in some sense premature. It is with us a time of breaking-up ground and sowing and planting, not a time of reaping or gathering fruit, and unless this generation of Canadians is content, like those that have preceded it, to sow what others must reap in its full maturity, there will be little hope for our country . . ."

In chemistry at least the enterprise was not premature. It was undertaken at the beginning of a period which has seen the greatest developments in the history of that science. Other generations have gathered the fruit then sown. But it is still a time of sowing and planting and therefore of hope for this country. Again in the same address:

> "We must bear in mind, however, that we have still much to do to place us on a level with most other countries. With the exception of the somewhat meagre grants to the Geological Survey and to the Meteorological Service, the Government of Canada gives nothing in aid of scientific research . . ."

Three years later in the "Report on Fellowships" one finds that only one fellowship in chemistry was available in Canada, the "winner to assist in teaching." At the same time,

> "in the United Kingdom, very extensive provision is made for enabling students of promise to pursue their studies in the higher regions of learning, without distraction from the necessity of engaging in lucrative employment."

Much has since been done to place this country on a level with others. The grants of the Government for research are no longer meagre. Through the National Research Council, constituted in 1915, about one hundred and fifty young Canadians have received scholarships in chemistry, and many of these fill professorial chairs in Canadian universities. The new laboratories of the National Research Council in Ottawa show that again to-day as fifty years ago "this generation of Canadians is content, like those that have preceded it, to sow what others must reap in its full maturity."

Once more from the first Presidential Address:

> "Our men of science are so few and our country so extensive that it is difficult to find in any one place, or within reasonable distance of each other half a dozen active workers in science."

To-day, in at least one university, there are more than half a hundred young chemists engaged in active research.

In his address to the Society in the following year Sir William Dawson gave an admirable picture of the state of chemistry in Canada at that time:

> "Thus far we have made more progress in chemistry than in the other experimental sciences. The laboratory of the Geological Survey, established many years ago under Dr. Sterry Hunt and continued under Dr. Harrington and Mr. Hoffmann, has produced results not only of the greatest scientific and practical value to the country, but widely known abroad.
>
> "The laboratories connected with the leading universities have also done good work, more especially in mineral analysis. Nor should we forget that among our members are several chemists whose researches are widely known abroad and highly valued. It is a cheering feature in this department that so much is being done to train young men in practical chemistry.
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> "In my own university I find that there is accommodation for sixty-six students in practical laboratory work, and this is fully occupied during the session. Other universities I believe have similar facilities, etc. . . But it is to be hoped that some of the chemists trained in our colleges will follow up lines of original research."

On this continent Johns Hopkins University was the first to require research for a degree, that of the Ph.D. This was instituted in 1877.

Other universities were slow to follow, particularly those in Canada. Only since the beginning of this century have anything like adequate facilities for research been available in chemistry at Canadian universities.

In 1882 Section III had a total membership of twenty. Of these perhaps five were chemists. Geographically the Section extended from Halifax to Toronto. To-day about eighteen chemists are found among the sixty or more members of the Section, which geographically extends from the Atlantic to the Pacific.

In 1882 five chemists formed a far greater proportion of the total number of chemists in the country than do those eighteen or more who are to-day members of Section III. Is it any wonder that Canada's output in chemistry was small!

Interest then centred chiefly in analysis. Organic chemistry received little attention. Physical chemistry was just beginning its phenomenal career and developing rapidly in Germany. While not neglected in Canada, it is only in recent years that it has received here the attention that it deserves. It may be said that in the first twenty years of the Society the contributions of Canadians to the science of chemistry, while not unimportant, were few. The reason is not hard to find. Dr. James Loudon in his Presidential Address in 1902 stated:

> "But the British Nation is on the eve of an awakening, an awakening which has already taken place among certain leaders of thought. The fact is dawning upon the British mind that some vital connection really does exist between national progress and scientific discovery, and the latter should be fostered in connection with the higher institutions of learning."
>
> "Organized research in Canadian universities as a definite system can scarcely be said to exist as yet, although within the last decade certain beginnings have been made which indicate a movement in that direction."
>
> "The time is approaching if indeed it has not already arrived, when the research university must be regarded as the only university."

The last statement is as true to-day as it was thirty years ago. Canada has far too few universities with staff and equipment to qualify them as research universities. But the future is not discouraging, and we may well be proud of the progress made during recent years. The recognition of the value of research in industry is now almost universal. Canadian chemical industries have shown

a remarkable growth which has not been without its influence on the universities.

Though the Proceedings of this Society do not give a fair picture of chemical research in Canada, since probably the more important papers are published elsewhere, they do show that Canada's contribution is now large, and steadily increasing. Important contributions have been made to almost every branch of chemistry and the quality of these contributions shows that we are now on a level with many older countries.

Much remains to be done. It is still a time of sowing and planting, though many of the hopes of our first President have been realized.

It is unfortunate in these times that the Government should withdraw much of its financial support for chemical research. The significance of such work is still not obvious to the politician, though the future of our country must depend largely on the training of our young men of to-day.

> Lord Haldane has said "There are idealists in the cause of education and the way to move them is not to beg of them in the abstract, but to inspire them through the spectacle of the work actually done."

Surely Canadian chemists have supplied the necessary spectacle and from to-day should continue to hold their rightful place with those of other nations.

Fifty Years of Canadian Astronomy

By J. S. Plaskett, F.R.S.C.

The fifty years during which the Royal Society has been in existence have witnessed the rapid development of astronomy in Canada. In 1882, except for its use as a cultural subject in university work and in applications to time, navigation and certain surveying operations, practical astronomical work was limited to its use by the Federal Department of the Interior in the survey of Western lands and the delimitation and marking of International and other boundaries. With this and other Canadian astronomical work, the name of Dr. W. F. King, Fellow 1908-1916 and President, 1911-1912, is intimately associated and indeed Canadian astronomy may be said to have been founded and fostered by Dr. King. His first permanent appointment, June 13, 1881, was nearly coincident with the founding of the Royal Society, while the development of the science in this country for which, in the earlier years at any rate, Dr. King was so largely responsible, is contemporaneous with the growth and development of the Royal Society and should have a special interest on this occasion.

Mention should be made at this time of a society of amateurs interested in astronomy who commenced meeting in Toronto about the time of founding of the Royal Society. This included members from the meteorological observatory and the university and was developed under the fostering care of Prof. Chant, granted the name of the Royal Astronomical Society of Canada in 1902 and became national in character about 1907, forming sections at different centres throughout the Dominion. The work of this society in creating and maintaining interest in astronomy throughout the country has undoubtedly favourably influenced public opinion and enlisted public support for the science.

Although the pursuit of astronomy in a professional way in the first twenty years of this epoch was practically limited to the engineering schools and to the field astronomical work of the Department of the Interior, the vision of founding an observatory as headquarters for this work and for astronomical research was apparently early conceived in Dr. King's mind. The astronomical work of the Department was given a definite status and Dr. King was made Chief Astronomer in 1890. Even before this time he had advocated a modest observatory and although not at first successful had persisted in this object in his quiet but effective way. It was not, however, until

the administration of the Honourable Clifford Sifton as Minister of the Interior that success was finally attained. There can be no question that this success was due to Mr. Sifton's recognition of Dr. King's outstanding services to the country on boundary questions in general and in his preparation of the Canadian case for the Alaska Boundary Tribunal in particular.

The building of the Dominion Observatory, a handsome stone structure on the Experimental Farm at Ottawa was commenced in 1903, the 15 inch refractor was installed in 1904, the building occupied by the staff in the spring of 1905 and Dr. King named director in 1906. The inauguration of investigations on several phases of astronomy at this time may be considered as distinctly marking the second stage in the development of astronomy in Canada, which although proceeding slowly for the first half of the epoch we are celebrating, has been moving at an accelerating pace during the second part.

About the same time as research was instituted at the new observatory, the study of astronomy in Canada also entered on a new phase. It had previously been limited to a few lectures on general principles in the mathematical departments of the universities or to instructions on the practical applications to time, latitude, longitude and azimuth in the engineering schools. It was now elevated to the dignity of a course at the University of Toronto under Prof. C. A. Chant, and it is not hard to believe that this was the result of the founding of the observatory and the need for trained technical men to carry on its work. However that may be, the quality of the instruction is fully attested by the fact that practically all the workers at the two Canadian national observatories are graduates of Toronto. All Fellows will rejoice that Chant's unselfish and valuable services to astronomy have been recognized and that his unceasing advocacy of additional astronomical equipment for the University is to be met by the munificent gift of a completely equipped observatory with a 74 inch reflecting telescope. This is to be erected as a memorial by his widow to the late David Dunlap, who owed his interest in astronomy to the effective advocacy of Prof. Chant.

The scientific work of the Dominion Observatory was organized by Dr. King into three main divisions (*a*) Geophysical work, including seismology, terrestrial magnetism and gravity under Dr. Otto Klotz. (*b*) Meridian work, including the determination of time, of longitudes and latitudes across Canada, and of the absolute positions of a selected programme of stars under Mr. R. Meldrum Stewart. (*c*) Astrophysical work with the 15 inch telescope and a horizontal solar telescope by the present writer. It is worthy of note that all three

men, as well as Dr. King, were Fellows of the Society and each have contributed to its Transactions.

The work of the Geophysical Division can scarcely be termed astronomical and space does not permit more than a brief mention of the valuable work done, especially in seismology, under the able personal direction of Dr. Klotz who was associated with Dr. King from the first and ably assisted in the efforts to establish the observatory. After Dr. King's death in 1916 Dr. Klotz succeeded as director 1918-1923.

The work of the Meridian Division, besides the practical applications to the determination of time and longitudes and the maintenance of an accurate time service in the Ottawa Government buildings, has embraced an extended scientific programme for the determination of star positions by the meridian circle. Although I am not familiar with the progress of this programme, owing to my departure from Ottawa fifteen years ago, I know that meridian work is a slow process and does not lend itself to the rapid returns so often achieved in astrophysics. Consequently, I must be content with this brief summary of this very necessary and valuable work. I can testify, however, to the marked ability shown by Mr. Stewart in practically rebuilding and improving a very defective meridian circle, to his originality and thoroughness in the development of very accurate time determinations by use of the most modern clocks along with many ingenious accessories of his own design. Accurate time is, of course, a prime requisite in meridian work and forms the basis of the time service to Government buildings. As is well known, Mr. Stewart succeeded Dr. Klotz as director of the observatory in 1924 and under his able administration the research work of the institution is being continued.

The work of the Astrophysical Division consisted mainly of stellar and solar spectroscopy and soon developed into an active part of the research at the observatory. Here also many improvements were effected. The original spectrograph was replaced by modern instruments of home design constructed in the observatory workshop, while a new photographic corrector for spectroscopic work on the 15 inch visual telescope was tested and corrected for aberrations. The equipment became the most efficient of its size extant and an extended programme for the observation of spectroscopic binaries was undertaken coincidentally with numerous researches on improvements in spectroscopic methods. So successful was this work that the project of the writer for a large reflecting telescope for Canada was heartily endorsed at a meeting of the American Astronomical Society in Ottawa in August 1911.

In this, the third stage of the development of astronomy in Canada, the Royal Society had a more direct and active part. As an election and change of government almost immediately followed the forwarding of the above recommendation, the project was shelved and was not revived until the May 1912 meeting of the Society in Ottawa, just twenty years ago. A strong memorial was prepared and presented to the Prime Minister, Sir Robert Borden, by a representative deputation from the Society. Although not immediately successful, it undoubtedly had considerable educational influence and was a factor in the final success. The most useful result, however, was the insertion of a clause in the memorial, on the insistence of Prof. McLennan, although against the judgment of Dr. King and myself who feared the additional cost involved might prejudice the success of the project, that the telescope should be erected at the most suitable astronomical location in Canada.

Success in this ambitious plan was only finally attained after an intensive campaign among Members of Parliament and Ministers, resulting in authorization of enquiries and of calls for tenders in February and the letting of contracts for a 72 inch reflecting telescope in October, 1913. The enquiries into astronomical conditions at five selected locations were conducted by Mr. W. E. Harper, one of our Fellows and now assistant director at Victoria, and showed that probably twice as much work of higher quality could be accomplished at Victoria than would be possible at Ottawa. The location at Victoria was later authorized and this action of the Royal Society has thus been of inestimable advantage in the work.

The Dominion Astrophysical Observatory commenced observational work in May 1918, 14 years ago, with the director and an astronomer, to whom were added two astronomers in 1919 and a fourth in 1927. Except for changes in personnel, due to three of them accepting better positions, the number has remained the same throughout. Notwithstanding this small staff the observatory has achieved an enviable record for the quality and quantity of the work accomplished during the short time since establishment. This record could only have been attained through the ability and enthusiastic energy of the members of the staff and this has been fully confirmed by the election of four to Fellowship in the Society. It may be permitted, therefore, for the director to give a short summary of some of the advances resulting from these activities. The work has been almost wholly spectroscopic and in the fourteen years over 20,000 stellar spectra have been photographed. From these spectra the radial velocities of some 1650 stars out of the 6700 known have

been obtained, the spectroscopic absolute magnitude and parallax of 1100 stars out of some 3000 have been derived, 350 spectroscopic binaries out of 1300 discovered and 111 orbits of the 330 now known have been obtained.

Useful though this statistical work is, the results of auxiliary and independent investigations have been even more important. A few of the most noteworthy may be mentioned. The atomic constants were shown to be identically the same in the atmospheres of the hottest and most distant stars as on the earth, an experimental proof of the universal nature of physical constants. A new method of stellar spectro-photometry was developed with important applications to stellar, nebular and terrestrial spectra. The broad emission bands in the mysterious Wolf-Rayet spectra have been shown to be probably produced by the continuous emission of atoms from the stars at speeds of the order of 2000 km./sec., while Nova and P Cygni emission probably have the same origin. Another important result of the work at Victoria has been the convincing demonstration of the rotation of the galaxy around a very distant centre in the direction of Sagittarius in about 250,000,000 years. Probably the most important research has been concerned with the presence and properties of diffuse gaseous matter in the galaxy. This interesting example of the effective combination of experiment and theory began effectively with the demonstration at Victoria about eight years ago of the presence of widely extended and nearly stationary diffuse gases in the space between the stars through which the high temperature stars are rushing about in all directions. From these observations, Eddington theoretically deduced that the maximum density of this gaseous substratum would be 10^{-24} gm/cm^3 with an effective temperature of some 12000° K. More recent work at Victoria, now being published, has convincingly shown that this gaseous matter is uniformly distributed and partakes with the stars in the rotation of the galaxy. Further, it provides the most accurate method available for deriving the intrinsic luminosity and distance of the very hot stars. This combination investigation undoubtedly marks a major advance in cosmology and it should be gratifying to the Fellows that Canada has had so large a share in its development.

I have attempted to show in this summary that the origin and development of astronomy in Canada and of the Royal Society have been practically contemporaneous, that those most prominent in the development of astronomy have been Fellows of the Society, and that, especially in the later stages, this development has been materially influenced and advanced by the Royal Society.

*Some Aspects of the Geological Studies of the Canadian Shield 1882 to 1932**

By G. A. Young, F.R.S.C.

By 1882 the outline of the area of the Canadian Shield had been defined and exploratory geological work had been done in many districts. Though only a small part of the Shield, perhaps one-tenth of it, had been hurriedly traversed, and though the areas so examined lay mainly in one province, Ontario, geologists were confident that the geological features of the whole Shield followed a comparatively simple pattern duplicated again and again.

The oldest rocks were the Laurentian, and they were conceived of as being sediments, perhaps in part of special types not duplicated amongst the strata of later geological systems. They consisted of two major divisions, the Lower and the Upper Laurentian. The Lower Laurentian or, as it presently was termed, the Fundamental Gneiss, was known to be widespread, and was inferred to extend over the whole Canadian Shield forming the basement on which all later Precambrian rocks rested. The Lower Laurentian rocks were described as being foliated and banded gneisses grading into rocks not unlike granites. But the foliation and banding were regarded as being relics of bedded structures, and the whole assemblage was held to be composed of highly altered sediments.

The Upper Laurentian or as it was also named, the Grenville series, was known to extend from the shores of Georgian Bay eastward through Ontario into Quebec. So far as known it was confined to this southeastern part of the Shield, and throughout its extent it was intricately involved with the Lower Laurentian, the two having been folded together. The Grenville series was characteristically composed of crystalline limestone, quartzose rocks, and many varieties of banded gneisses, all considered to have been sediments, and to have been deposited in a sea or seas.

The next youngest assemblage constituted the Huronian system typically developed in a broad, irregular band extending from the north shore of Lake Huron northeastward past the head of Lake Timiskaming. Other areas of Huronian were known to the west and northwest of the main area, but none had been recognized east of it. The Huronian consisted in part, of sediments, but the greater

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part was composed of schistose and massive, crystalline rocks of volcanic origin. The Huronian strata were surrounded by the Lower Laurentian on which they lay, with, in most places, an appearance of conformity for the foliation and banding in the bordering, supposedly sedimentary Laurentian seemed to parallel the line of contact, and in places the strata of the two systems seemed to grade into one another. The evidence as then interpreted, at least indicated that the Huronian and Lower Laurentian had been folded together. Thus the relations of the Huronian to the Lower Laurentian were similar to those existing between the Grenville and Lower Laurentian, and it was suspected that the Huronian and the Grenville might be of the same age. If the Grenville as a whole were not a phase of the Huronian, then at least a part of it known as the Hastings series (occurring in Hastings and adjoining counties) was in all probability Huronian.

Later than the Laurentian and Huronian were many bodies of igneous rocks, granite, anorthosite, etc., and invading the Huronian were bodies of diorite so-called, but presumably, diabase. All these intrusive bodies were regarded as being of Huronian age.

Youngest of all were certain assemblages of, on the whole, gently inclined, relatively unaltered sediments and volcanics, such as the Animikie and Keweenawan that border the shores of Lake Superior. These groups were considered to be relatively young, and not unlikely, of Cambrian age.

These were the main ideas concerning the Precambrian succession in the Canadian Shield current in 1882. They were founded almost exclusively on observations made in southern Ontario and southwestern Quebec. To this day by far the greater part of the geological investigation of the Canadian Shield has been concentrated in the same region.

The relatively simple conception of the stratigraphy of the Canadian Shield held in 1882 was not long maintained. Lawson in 1885 demonstrated that in the Lake of the Woods district the Laurentian behaved towards the Huronian as an intrusive igneous mass. He showed that foliation and banding as exhibited by the Laurentian had nothing to do with bedding. The Laurentian rocks possibly had been sediments or a part of the original crust of a cooling earth but if so they had been fused, and thereby transformed into granites. A few years later, Barlow gave evidence to show that the Laurentian bordering the southeastern side of the Huronian band, stretching northeast from Lake Huron, was also intrusive into the Huronian. At about the same time Adams commenced an investigation of the

Laurentian strata in eastern Ontario, and neighboring parts of Quebec, and eventually demonstrated that there also the Lower Laurentian were igneous rocks younger than the associated sediments which in this case belonged to the Grenville series. In the course of some ten or fifteen years it became established that the Laurentian rocks, instead of being older than the Huronian or Grenville, as the case might be, were everywhere younger than and intrusive into them. The idea that the Laurentian granites might be fused parts of an original foundation and of the overlying strata was maintained until early in the present century.

The next radical change in the conception of Precambrian stratigraphy was mainly due to Coleman. In the opening years of the present century he marshalled evidence to show that the Huronian consisted of two great series separated in time by an interval of pronounced erosion. The Lower Huronian consisted predominantly of volcanic rocks with, towards the top of the division, siliceous and ferruginous members known as iron formation. The Upper Huronian consisted of sediments and volcanics in varying proportions with a basal conglomerate holding water worn fragments of the Lower Huronian. The iron formation was widely distributed throughout the Huronian areas, and the conglomerate was equally widespread, and thus it was practicable to subdivide the Huronian. This general conception was accepted by all geologists, and for several years the terms Lower and Upper Huronian were employed with the significance given them by Coleman.

In 1904, however, Barlow showed that in the Lake Timagami region only the Lower Huronian was penetrated by the Laurentian granites, whereas the Upper Huronian rested on a deeply eroded surface truncating the Laurentian granites and the still older schistose Lower Huronian volcanics. In 1905, as a result of the publication of the findings of an international geological committee, the strata heretofore designated Lower Huronian became known as the Keewatin, and the strata that had been called Upper Huronian then became the Huronian. The name Keewatin had long before been applied to the volcanic assemblage developed west of Lake Superior, and which for many years had been considered to be of Huronian age, and latterly, Lower Huronian age. The assumption that the volcanic assemblages termed Keewatin are everywhere in Ontario of the same or approximately the same age was questioned by some geologists, but no doubt existed as to all being of pre-Huronian age. Furthermore there seems to be at present a general belief that the more ancient great volcanic assemblages found throughout the length and breadth

of the Canadian Shield are all of pre-Huronian, *i.e.*, Keewatin age. This belief is based on the general similarity exhibited by these groups, and above all, on the fact that in any given region they are the oldest or are closely associated with the very oldest strata, are penetrated by granites and are folded. Long ago, in 1897, G. M. Dawson drew attention to the prevalence of such ideas, and to the possibility that they were erroneous. He pointed out that structurally such assemblages had the appearance of being the deep-seated parts of once mountainous areas. But, he argued, the great extent of the region seemed to imply that the mountains could not have been produced everywhere at the same time, they surely formed at different times in different places. Since mountain building, batholithic invasion and great erosion seem to be linked processes, Dawson's argument means that it is improbable that the Keewatin or Keewatin-like assemblages are everywhere of the same general age.

The international committee already referred to, also proposed that Laurentian should be the name of the post-Keewatin pre-Huronian granites, but Canadians were aware that granites apparently indistinguishable from the Laurentian did, in certain districts, cut sediments considered to be Huronian. This difficulty was presently (in 1911) resolved by Miller by the finding in the Lake Timiskaming district of a sedimentary series named by him, Timiskaming, that was older than the Huronian and younger than the Keewatin, but was cut by the granites cutting the Keewatin. A somewhat analogous series was recognized by Coleman in the Sudbury district, and the apparent anomalous behaviour of the so-called Laurentian batholiths which in one district cut what seemed to be Huronian, and in another district were much older than the Huronian, was explained. The granites were of the same age, but two sedimentary groups had been confused, one of which belonged to the Huronian, whereas the other was pre-Huronian, but post-Keewatin. But the difficulty with respect to the granites was only one step further removed for the Timiskaming and the Sudbury conglomerates held pebbles of granite thus indicating the existence or former existence of another and older granite. This older granite had not been found but might still exist, and the question arose as to which granite was Laurentian, the one cutting the Timiskaming, or the older one indicated by the pebbles in the Timiskaming conglomerate.

By 1913 the general succession in the region extending from Sudbury northeast to Lake Timiskaming seemed to have been established, and both Coleman and Collins outlined the stratigraphical

succession. This was particularly complete in the vicinity of Sudbury, for there in addition to the other members, there was a sedimentary assemblage, the Whitewater series, long before recognized as being younger than the Huronian, and claimed by various geologists to be an equivalent of the Animikie or possibly the Keweenawan. Thus there was some hope that the succession at Sudbury might prove the standard for the Canadian Shield if the age of the Grenville series could only be determined. The succession at Sudbury, as it was understood in 1913, was, in ascending order: Keewatin series; unconformity; Sudbury series (presumably equivalent to the Timiskaming series); Laurentian batholithic rocks, and great erosional break; Huronian; unconformity (?); Whitewater series, perhaps of Animikie age.

The above stated succession, however, proved to be incomplete, for in 1914 Collins, who in previous years had traced the Huronian assemblage (Cobalt series) of Cobalt and neighboring districts south to Sudbury, carried his investigations southwest to the shores of Lake Huron, and found that beneath the Cobalt series, and separated from it by an erosional unconformity lay another sedimentary series to which he gave the name, Bruce series. In 1916, Collins found that along the Lake Huron shore, the Bruce series was invaded by batholithic bodies of granite, the Killarney granite. Later Collins was able to satisfy himself that the Killarney granite was younger than the Cobalt series also, and might even be of Keweenawan age. Still later, in 1925, Quirke announced that in the district bordering the northeast angle of Lake Huron where the Huronian is invaded by the Killarney granite, the Huronian measures entangled in the granite graded into gneisses and other rocks indistinguishable from the Grenville series, and that in all probability the Grenville strata were Huronian. A few years later, Collins and Quirke in a joint report presented arguments showing that the Killarney granite represented transformed sediments.

The extent of the Killarney granite is unknown. It reaches at least as far north as Sudbury. Possibly it continues eastward through the region occupied by the Grenville series, for many determinations by Ellsworth of the ages of minerals in pegmatites by means of the lead-uranium plus thorium ratio give concordant results indicating that the pegmaties are about 1,200 million years old. If the Grenville series or some part of it is Huronian, and if all the invading batholithic rocks are of one age then the granitic rocks would, presumably, be Killarney, but since the Grenville series lies in the type area of the Laurentian this is equivalent to stating that the term Laurentian

should be used instead of Killarney. The Laurentian granites instead of being the oldest granites would be the youngest. However, Miller and Knight, have claimed that in the Hastings region there are two granites. These authors state that in this region the oldest rocks are a volcanic assemblage to be definitely correlated with the Keewatin. The volcanics are overlain by a sedimentary series (Grenville series) and the whole assemblage is invaded by granitic rocks classed as of Laurentian age. Younger than the Laurentian granites is another sedimentary series (the Hastings series) and this is invaded by a still younger granite. Other investigators, however, have failed to find evidence of two periods of batholithic invasion, and neither are all geologists prepared to accept the view that the Grenville-Hastings assemblage represents the Huronian.

Mention has already been made of the occurrence in the region north of Sudbury, of the Timiskaming sedimentary series. This series characterized by the presence of a basal conglomerate holding granite pebbles, occurs in various places in considerable volumes. It is younger than the neighboring Keewatin, and is separated from it by an erosional unconformity but is folded with the Keewatin, and both are invaded by the widespread, pre-Huronian granite of the region. Miller and Knight have correlated the Timiskaming series with many sedimentary assemblages distributed across Ontario from Quebec to Manitoba. One such correlative is the Seine series developed in the Rainy Lake country, and so named by Lawson as a result of a restudy of the district in 1911. Lawson found that the Seine strata were penetrated by granite, but in places rested on an older granite cutting nearby Keewatin. The older granite he termed Laurentian, to the younger he gave the name Algoman. The Seine series is thus much younger than the Keewatin, and Lawson claimed that it is of Huronian age. If he is correct in this contention, then the Seine is much younger than the Timiskaming series.

The possibility remains that the Seine is neither of Huronian nor of Timiskaming age. In Michipicoten district Collins and Quirke have discovered a conglomerate series that may be older than the Timiskaming. It holds granite pebbles derived from a nearby granite body. This conglomerate, the Dore conglomerate, lies within the great volcanic assemblage commonly termed Keewatin. Furthermore, it apparently marks a great erosional break within the so-called Keewatin, the older part of the Keewatin having been invaded by granite and eroded prior to the deposition of the Dore conglomerate and succeeding part of the Keewatin. In eastern Manitoba conglomerates holding pebbles of granite and associated with other

sediments have been described by Wright as occurring within a volcanic series that can hardly be anything but a western continuation of the Keewatin of western Ontario. In the case of the Manitoba occurrences, the sedimentary assemblages do not appear to mark breaks within the volcanic assemblages for sediments, and volcanics grade into one another along the strike. Thus it appears that in the pre-Huron complex conglomerates and other sediments may occur at different horizons, and positive evidence is lacking that the granite pebbles of different conglomerates were derived from granite bodies of like ages.

The foregoing account has dealt only with the results of investigations in a small southern part of the Canadian Shield, and attention has been directed almost entirely to matters of stratigraphy. During the period under review much work has been done in other parts of the Canadian Shield, but this work cannot be surveyed in an article as short as this must be. Nor is it possible to deal with many other notable changes that have come about in our conception of the geology of the Canadian Shield, such as the discovery by Coleman that the basal conglomerate of the Cobalt series is a tillite. Enough has been written to give an indication of how great a change has been brought about in the last fifty years in the understanding of the geology of the Shield. And perhaps it has been made apparent that much remains to be learned, for it can scarcely be assumed that ideas now current are sounder or will survive longer than those current thirty or fifty years ago.

Fifty Years of Pleistocene Geology in Canada

By W. A. Johnston, F.R.S.C.

During the early part of this period, from 1882 to about 1895, opinions held by many geologists in Canada regarding the character of the Pleistocene or glacial period were greatly influenced by the writings and teachings of Sir William Dawson, who believed that much of the glacial drift was deposited by floating ice during one or more times of marine submergence and that only local glaciers existed in highland regions. Objections to the glacial theory, which implies that extensive ice-sheets covered nearly all Canada, were based mainly on the belief that it was physically impossible for an ice-sheet to have formed in north central Canada sufficiently thick to have moved south and in places uphill for hundreds of miles. Nevertheless it is now known that this is what did happen, though there are still marked differences of opinion as to the extent of the ice-sheets and the occurrence in eastern Canada of local glaciers rather than a single large ice-sheet.

Among the early workers who, like Sir William Dawson, opposed the glacial theory, in part at least, were G. M. Dawson, whose work lay chiefly in western Canada and forms the basis of our knowledge of the geology of that region; J. W. Spencer, who investigated the raised beaches of the Great Lakes region and Niagara gorge; and Robert Chalmers, who worked mainly in eastern Canada. There were a few geologists, notably G. J. Hinde, who even at the beginning of the period supported the glacial theory. As early as 1877 Hinde described the interglacial beds at Toronto, later made famous by the work of A. P. Coleman.

G. M. Dawson's work in western Canada led him finally in 1897 to accept the glacial theory in large part. In fact it was he who named and described the Laurentide glacier as occupying the Laurentian highlands east and west of Hudson bay, and the Cordilleran glacier as covering a large part of the mountain region in British Columbia and Yukon. Even in his latest writings, however, he did not accept the glacial theory entirely. He held that the "white silts" which extend up to 4,000 feet in British Columbia were marine and that the Precambrian boulders which he found up to 5,000 feet in southern

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Alberta also were marine; it seemed to him more reasonable to suppose that the boulders were transported by floating ice in the sea than to imagine that an ice-sheet had transported them for 700 miles from the northeast—the nearest possible source—and uphill for 3,000 feet. Similarly in eastern Canada it was held by Chalmers and others that much of the glacial drift was transported by floating ice and that the Laurentide ice-sheet did not reach the Maritime Provinces but that local glaciers existed. Even to-day there is a marked difference of opinion as to the extent of local glaciation in these provinces.

The change in point of view regarding the character of the glacial period, namely, that the glacial drift was deposited by immense ice-sheets rather than by floating ice or by local glaciers and that the marine submergence around the present coasts extended only to a few hundred feet rather than to thousands of feet was due to the work of many geologists. Opinion was also influenced by the results of work in the United States and in other countries.

In the Prairie Provinces, Warren Upham, as early as 1887, discovered that old river channels leading south could have been formed only when the drainage to Hudson bay was blocked by an ice-sheet. He found that Lake Agassiz in Manitoba must have been ice-dammed; the lake beaches on the west side of the Manitoba lowland occur up to 1,500 feet whereas the divide to the north is only about 700 feet, so that the lake could not have existed unless all northern Manitoba was blocked by an ice-sheet. That the lake was ice-dammed had also been pointed out by N. H. Winchell in 1872. R. G. McConnell measured the thickness of the ice-sheet in southern Alberta by observing the upper limit of the drift on Cypress hills and determining its height above the surrounding plain. J. B. Tyrrell, who supported the glacial theory even in his earliest work in 1886 in Alberta, discovered, on his memorable trip through the Barren Lands, the Keewatin centre of glaciation and at a later date the Patrician centre. He found that the upper limit of marine submergence west of Hudson bay was about 500 feet. In British Columbia, R. A. Daly showed that the white silts which Dawson thought were marine were deposited in ice-dammed lakes; the marine submergence along the coast was found by various workers to be only a few hundred feet. It was impossible therefore to believe that the sea stood at 5,000 feet in southern Alberta; the Precambrian boulders there found at this great height must have been transported by the ice from the Canadian Shield to the northeast. To account for this remarkable feat of transportation, Ernst Antevs has recently estimated the thickness of the ice in the Keewatin centre to have been approximately 18,000 feet.

In the east the notable explorations of A. P. Low in northern Quebec showed that there were centres of glaciation of the Labradorean glacier which shifted from north to south and that the glacier covered practically the whole of this region. Chalmers held that the Labradorean glacier did not cross the lower St. Lawrence. But studies in recent years by J. W. Goldthwait showed that an ice-sheet coming from the north extended to the Atlantic coast of Nova Scotia; others, notably E. R. Faribault and T. L. Walker, hold that parts of Nova Scotia were locally glaciated, possibly in addition to the main glaciation. Coleman has pointed out that the higher parts of the Shickshock mountains in Gaspé were not overridden by the Labradorean ice-sheet, but that a lobe invaded New Brunswick by way of the lowland east of Gaspé. Work south of the Great Lakes, notably by Frank Leverett in tracing the moraines formed by the last ice-sheet—for there was more than one stage of glaciation—definitely showed that the ice-sheet at its maximum extended from Cape Cod and Long island on the east to the Dakotas on the west. These findings markedly influenced opinion in Canada regarding the extent of the ice-sheets. The fact that the ice-sheet overrode the highest mountains in New England indicated that it probably covered much of the Maritime Provinces.

Studies of the high-level abandoned beaches in the region of the Great Lakes influenced opinion regarding the character of the ice age in eastern Canada for the beaches eventually proved to be ancient shore-lines of ice-dammed lakes rather than marine shore-lines, as was formerly held by many geologists. In addition to J. W. Spencer, who named and described two of the most important of the glacial lakes, there were a host of workers who studied the beaches. Among these were G. K. Gilbert, Frank B. Taylor, A. P. Coleman and J. W. Goldthwait. Proof that the ancient lakes were held in on the northeast side by the ice-sheet was lacking for a long time owing to the fact that it was impossible to trace the beaches in the rocky region north of the Great Lakes. It was finally supplied by Coleman's investigation of the Iroquois beach; the beach ends in a morainic area, marking a former position of the ice border, north of the eastern part of Lake Ontario. Furthermore, Gerard de Geer, a Swedish geologist, found that the upper marine limit in the Ottawa valley was about 700 feet, whereas the old lake beaches to the west are several hundred feet higher. An incident which illustrates the difficulty that many geologists had in accepting the glacial theory is the following. Spencer in 1888 discovered the outlet channel, by way of the Trent valley, which connected Lake Algonquin in the upper Great Lakes basin with Lake

Iroquois, at a much lower level, in the Ontario basin, and many years later rather bitterly complained that he had not been given credit by Gilbert for this discovery. But he had disregarded his own discovery apparently because it had conflicted with his view that the beaches were marine. To his credit be it said that he finally accepted with good grace the glacial lake theory.

A widely accepted view, originating with Tyrrell and G. M. Dawson, that there was an eastward migration of the centres of glaciation and that the Cordilleran glacier nearly disappeared before the Keewatin and Labradorean glaciers in turn reached their maximum is no longer held. Dawson gave the name Albertan to the Cordilleran drift which he regarded as the oldest of all the drifts, but W. C. Alden has shown that part of the mountain drift in southern Alberta is practically contemporaneous with that derived from the Precambrian area to the northeast and that there are, probably, at least two drifts from each source. Upham showed that very old drift occurs in the eastern States as well as in the west, and Coleman holds that there is old drift in eastern Canada, though it has not been generally recognized.

The subdivision of the Pleistocene into four or five glacial stages and three or four interglacial stages, that has been developed by many years of field studies in the United States, has not been found entirely applicable to Canada. At Toronto and in the Moose River basin in northern Ontario there is one series of interglacial deposits containing fossils that indicate a climate as mild or milder than the present during a period of deglaciation when the ice-sheets must have disappeared almost entirely. In all the western provinces there are also occurrences of at least one series of interglacial beds, and in Saskatchewan probably two with three series of glacial deposits. Curiously, in eastern Canada there are few if any definite occurrences of interglacial warm climate beds. Goldthwait found evidence of only one glaciation in Nova Scotia. Coleman, however, has pointed out that there were two glaciations in the lower St. Lawrence region and that the later one was much less extensive than the earlier one; parts of the highland areas in Newfoundland and at other places in the Gulf region were not covered by the latest ice-sheet. M. L. Fernald holds that these areas formed refuges during the last glaciation for a large series of endemic plants characteristic of the region. As many of the plants, however, are found in areas that were glaciated, for example on the Mingan islands, this question can hardly be regarded as settled.

Photographs from the air, taken during the past few years for the purpose of mapping parts of northern Canada, have shown that a few

glaciers actually exist east of the Rockies though this was formerly believed to be very improbable. One of these areas is in the Torngat mountains in northern Labrador, an area which Coleman examined in part and found that it was untouched during the Pleistocene by the Labradorean ice-sheet but had been deeply eroded by local glaciers. Another is in the Barren Lands of north central Canada where tiny glaciers in protected nooks along some of the river valleys form "land" marks for the airmen. They show what a narrow margin exists in this region between glaciation and the general absence of glaciers. Large glaciers probably do not exist merely because of the small snowfall.

A notable contribution to the Pleistocene geology of Canada is the work, during the past few years, of Ernst Antevs, who has sought to make an actual time scale for the period since the last ice-sheets began to disappear. He has done this by counting and correlating from place to place the annual clay layers or varves laid down in glacial lakes during the retreat of the ice. These layers have been proved to be annual by the fact that similar beds are being formed in lakes such as Lake Louise that are fed from glaciers. The work is far from complete and there are many gaps in the series, but Antevs has estimated from his work in the United States and in Canada and partly by analogy with Europe, where much similar work has been done, that the time that has elapsed since the glaciers began to retreat may be 40,000 years and the time since their final disappearance about 9,000 years. The results are of especial interest as other methods of determining post-glacial time have not been very successful. One of the best known methods is by estimating the rate of formation of Niagara gorge which has been formed in post-glacial time by recession of the falls for seven miles. Many investigations have been made by Gilbert, Taylor, Spencer and others and the time estimates have usually ranged from 25,000 to 35,000 years or somewhat more. Sir Charles Lyall's original estimate, made in 1841, of a foot a year for the seven miles of gorge may be nearly as accurate, for the rate of formation of the gorge varied greatly from time to time and part of the gorge is a re-excavated interglacial channel, so that it is difficult or impossible to determine the rate of recession of the falls at different times, although the rate in recent years, amounting to about four feet a year, has been fairly accurately determined.

The Growth of Theories of the Formation of Ore Deposits in the Last Fifty Years[1]

By H. C. Cooke, F.R.S.C.

Curiosity is inherent in all animals, and its intensity seems to be proportional to the creature's gray matter. In man, top of the animal kingdom, curiosity is the most outstanding characteristic; so that he can see no phenomenon, from the conduct of his neighbor's wife to the transit of the sun across the heavens, without endeavoring to learn its explanation. Because the results of this curious, inquiring habit have frequently proved beneficial, we now dignify certain forms of it with high-sounding names such as research or scientific inquiry; and we justify its existence, particularly to those who have to supply the necessary funds, by pointing out the valuable results of the past, and those which we hope may accrue in the future; but there can be no doubt that the compelling motive behind research is not the possible obtaining of valuable results, but an insatiable curiosity as to causes. The successful investigator has never been he who worked merely for his day's wages or for any other tangible reward, but always he who could not see a problem without grappling with it, playing with it, attacking it from all angles till he finds the chink in its armor enabling him to penetrate its heart. If economic results follow, he will proclaim them as his justification, but he finds his real justification in his own soul, and would be equally satisfied whether the work were lucrative or no.

From the earliest times the existence of mineral deposits has been a fertile cause of speculation. The localized occurrence of a large body of metalliferous ore, at once so valuable and so different from the surrounding rocks, is in truth an extraordinary phenomenon. Where did it come from? How did it get there? Why is it thus concentrated? These are questions that have always intrigued the mind and incited investigation. We justify the expense of investigation by pointing out that we must answer these questions in order to find an answer to a fourth, namely, "Where can we look for more, with some certainty of success?"; but there is no doubt that the investigation would still be carried on, by those financially able to do it, were there no likelihood whatever of a monetary return.

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One of the earlier theories was that of Werner (1791), who thought that the sea, at certain times or in certain places, became saturated with metallic salts, which thereupon precipitated in the chance cracks and fissures of the sea bottom. It became obvious, however, that if veins were formed in this way some should have a T-shape, the upright part of the T being the vein itself, and the horizontal bar representing vein-matter precipitated originally on the sea bottom. As no such shapes could be found, the theory fell gradually into disrepute.

Another early theory supposed that veins were injected as molten fluids, like the dykes of the igneous rocks. It is interesting to note that this idea, after having been discarded for nearly a hundred years, has recently been revived in slightly modified form to explain the origin of certain types of veins, like the gold veins of the Canadian Shield; but it did not explain the prominent features of the veins then known, such as their comb structure, their crustification, and the changes they underwent when passing from one rock into another; so that this theory also was discarded.

According to a third hypothesis, metalliferous materials were converted into vapor by the internal heat of the earth, and in this form rose through cracks until precipitated by cooling, or by mixing with other vapors. Laboratory experiments proved that such an origin was possible, and deposits of sulphur and other minerals are known to have been formed in this way around volcanoes. It was pointed out, however, that the quartz, carbonates, and other earthy constituents of veins could not have been formed thus; and the theory was consequently abandoned for all but a very few types of deposit.

Passing some minor theories without mention, we come to the theory of lateral secretion, held by many eminent geologists about the middle of last century, and very greatly strengthened by the researches of Professor Sandberger, of the University of Wurzburg, which were begun about 1873. Sandberger made a great number of painstaking chemical analyses of the minerals of rocks of all types, and from many different districts, and more particularly of the basic minerals, the hornblendes, pyroxenes, olivines, and micas; and determined that these minerals contained appreciable quantities of metals. In olivine, for example, iron, nickel, copper, and cobalt were constantly recognized, though the latter metal was always in very small quantity. In the augites of the basic rocks he found copper, cobalt, and iron in notable quantities, and nickel, tin, lead, zinc, antimony, and arsenic in certain localities. Space forbids a fuller statement of his results, but from these and many similar

determinations he concluded that rain water, passing slowly downward through the pore spaces of the rocks, could leach out these metalliferous constituents and carry them onward in solution, to be precipitated eventually in the open fissures into which the groundwaters finally passed. Gradual deposition of the minerals from aqueous solution in open fissures explained the comb textures of the veins and their crustified structures; and the conception that the minerals were derived from the surrounding rock explained the changes in composition undergone by a vein where it passes from one rock into another. It also accounted for the manner in which shoots of ore followed the dip of the enclosing rocks.

The theory satisfactorily correlated so many facts that it was accepted for many years, up to and beyond 1882, the beginning of the fifty-year period under discussion. As more and more ore deposits were studied, however, objections began to appear. Different sets of fissures traversing the same rocks were found to contain very different ores. Fissures were observed to traverse several different formations, but the character of the vein material remained essentially the same throughout. To meet these and other objections the theory was modified by supposing that in some cases the ore-bearing waters had free upward movement in the fissures. Such fissures therefore became trunk channels to which were gathered the groundwaters which might have passed laterally through great thicknesses of country rock, gathering in their metallic constituents en route; and the vein materials deposited in such fissures need have no relation to the rock immediately adjacent.

About 1880 it also became recognized that many vein-forming solutions must have been hot. Vein quartz, examined under the microscope, was found to contain numerous little cavities enclosing a minute drop of liquid, much smaller than the cavity. It was reasoned that when the crystal was formed the enclosed liquid must have been hot enough to fill the space completely, and that it afterwards contracted to its present volume on cooling. By heating the mineral until the cavity fills and the empty space disappears, the temperature of deposition can be approximately determined. Experiments conducted along these lines indicated that the quartz must have crystallized at temperatures of 180°F. to 350°F. Again, hot alkaline springs were discovered in California and Nevada, from which quartz is now being deposited in abundance, together with sulphides of several of the metals. To meet these facts, the theory was still further enlarged to suppose that meteoric waters, in favorable localities, descended deep enough within the earth to become heated,

thus of course enormously increasing their solvent power, as well as their tendency to ascend through fissures. This was particularly likely to occur, it was supposed, in districts of recent volcanism, where bodies of only partly cooled igneous rock, or of country rock heated by igneous action, lay at moderate distances below the surface. This theory, known as the theory of ascending waters, prevailed until about 1900 or somewhat later, and was developed with great detail in that year in a paper by Van Hise.

The rapid increase of mining operations in the latter part of the last century, by which geologists were enabled to make direct observations on more and deeper parts of the earth's crust, threw doubt on the accuracy of the accepted theory. The rocks of the deeper mines were found to be dry, not filled with water, as according to theory they should be. Further, the minerals of most rocks, below the zone of weathering, were not leached and altered, as the theory would demand. About the same time also, (1900), a new possible source of water for vein-forming solutions was suggested by the distinguished Swedish physicist Arrhenius. He called attention to the great volumes of steam that escape from active volcanoes and cooling lavas, and advanced the suggestion that this water must actually have been dissolved in the molten rock, under the great pressures prevailing at the depths from which the lavas came. Proceeding farther, he reasoned that bodies of igneous rock which did not come to the surface before cooling must likewise have contained corresponding quantities of water, which of course must separate and escape when the molten mass solidified; and that this water, highly heated as it was, must be charged with mineral matters that would naturally be deposited on cooling. Experimental work in the laboratory, he pointed out, had already proved that water, heated under pressure to about 200°C., actively attacked and dissolved glass and other silicates.

This revolutionary conception was at once seized and developed by Vogt, Kemp, and other advanced thinkers; and although actively opposed for some years, gradually gained ground. It was greatly strengthened, on this continent, by the proof, advanced by Spurr about 1902, of the gradual transition existing in Fortymile Creek district, Alaska, between granite bodies and quartz veins; by the clear and convincing proofs adduced by Lindgren of the origin of the Clifton-Morenci copper deposits from the porphyries of the district, and by other data. As time went on, more and more examples of the connection between igneous masses and ore deposits accumulated, until it is now generally admitted that most veins were probably formed in this way.

This is the theory of juvenile waters, so-called because they attain the earth's surface for the first time. To one unfamiliar with the subject, the conception that water can be dissolved in molten rock must appear fantastic, but it has been proved both by direct observations in volcanic districts, as mentioned, and by laboratory experiment. The amounts of water that can dissolve in molten rock are almost unbelievably large. Recent experiments conducted by the Geophysical Laboratory, Washington, have indicated that at pressures of about 1000 metric atmospheres* and temperatures of 900 C., granite glasses will dissolve nearly 6% of water, or about 25 gallons per cubic yard. It is evident, therefore, that molten magmas afford an abundant source of vein-forming solutions.

This theory satisfactorily groups together and explains a greater number of phenomena than any previous conception. It is obvious that waters escaping from a cooling magma must be very hot and highly charged with mineral matter; and to solutions of this type are ascribed the coarse-grained mixtures of quartz and feldspar known as pegmatites, and those extraordinary aggregations of unusual minerals grouped under the general term contact deposits. Farther from their source the solutions would naturally become somewhat more aqueous and cooler, and are then capable of forming the deposits of the deep vein zone. To this type belong most of the Canadian gold deposits, the tin deposits of Cornwall, and many others. As the solutions continue to rise, depositing their mineral contents and becoming cooler as they do, still other types well recognized by geologists are formed. Finally the water, cooled and stripped of most of its mineral content, attains the surface as mineral springs. If hot, it may deposit a good deal of silica and other substances where it pours out on the surface; if cold, it may contain mineral substances in solution, but not enough to form a deposit.

So many evidences of the correctness of this conception have now accumulated, that it has passed from the status of a working hypothesis to that of an accepted theory. With the extension of our knowledge it has, also, undergone a natural growth. It has become evident, for example, that many vein-forming solutions did not merely rise through open fissures, but were forced into the rock under such tremendous pressure from below that they were able to drive the rock walls apart and make a space for themselves; so that they resembled igneous rocks in their behaviour rather than the more ordinary vein-forming solutions. Lack of space, however, forbids an extended discussion of further details.

*Roughly, 7 tons per square inch.

Trends in Fifty Years of Canadian Stratigraphy[1]

By F. H. McLearn, F.R.S.C.

By 1882, in the old world, the idea of a definite succession of strata had grown up and the value of fossils in correlation had been recognized. Evolution had permeated geological thought and the orderly development of animal and plant life was becoming accepted as the basis of chronology. In Canada the Geological Survey was forty years old. The work of Logan, its founder and an able stratigrapher, was done. E. Billings had laid the foundations of Canadian palaeontology.

In the following years investigations were made all over Canada. At first as part of exploration the study of stratigraphy was general. Later, because of the demands of economic work, it became more and more detailed. With this came a new viewpoint. Stratigraphy came to be not an end, but a means to an end. No longer was the erection of geological systems, the delimitations of formations and the establishment of fossil chronologies the goal of investigation. The established criteria could now be used to date igneous intrusions, volcanic eruptions, folding of mountain ranges, advances and retreats of seas, building out of marginal alluvial plains into the shallow epicontinental seas and all the phenomena of historical geology. They could also find a practical use in the mapping and structural studies of oil and gas fields, the tracing of water bearing strata, coal seams, beds of fireclay and other economic deposits. So stratigraphy came to play a fundamental part in geological investigation. In its new sphere of usefulness stratigraphy has been exploited in all its possibilities. More and more refined zoning has been sought. All the animal and plant groups have been explored for chronological data. Lithological criteria too have been used and criteria based on heavy mineral suites have not been neglected. It would not be possible in these few pages to recount all the achievements of Canadian stratigraphy during the past fifty years. Only a few examples can be given.[2]

In the Maritimes in 1882 two men were still working who had taken a prominent part in laying the foundations of Acadian geology, the

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[2]For a more comprehensive review of Canadian stratigraphy and palaeontology see Presidential address by W. A. Parks, Proc. Roy. Soc. Can., ser. 3, Vol. 16, sec. 4, pp. 1-46 (1922).

Rev. David Honeyman and Sir William J. Dawson. Both had begun their investigations in that inspiring period which had followed the publication of Murchison's Silurian System. Honeyman's main contributions were to the Silurian, Dawson's to the Carboniferous. The study of the Carboniferous illustrates the practical application of stratigraphy. The mapping of the coal bearing formations and the locating of individual coal seams created a demand for stratigraphic work. By 1882 Dawson, Logan, Lyell and others had recognized five units in the Acadian Carboniferous. In the following years intensive mapping was done by Fletcher, Robb, Poole, Bailey, Matthew, Ells and others. Valuable aid was given to mining development. Unfortunately too great a stress was laid on lithological criteria and errors of correlation crept in. Later W. A. Bell has returned to the palaeobotanical studies of Dawson. A combined floral and faunal succession of eight zones in the Carboniferous and one in the Permian has been worked out. The Lower Carboniferous or Mississippian Horton series has two and the Windsor series two zones. The Upper Carboniferous or Pennsylvanian Hawkesbury series has one, the Cumberland series one and the Pictou series two zones. Through this zoning the errors due to misleading lithological criteria have been corrected, more reliable correlations and more exact mapping and structural studies in the coal fields have become possible, the positions of some doubtful formations have been more definitely fixed and the Carboniferous diastrophic history of the Maritimes has been partially worked out. The fixing of the age of certain formations such as that of the New Glasgow conglomerate permits a forecast of whether productive measures can be expected below them.

The investigation of the Upper Ordovician of Ontario by W. A. Parks, his students and others has resulted in the establishment of three formations, eight members and numerous fossil zones. It is cited as an example of the great volume of stratigraphic work that has been done in Ontario and Quebec.

By 1882, the study of the Cretaceous and early Tertiary of the western Great plains had already passed through a stage of geographic exploration and geological reconnaissance. It was now entering a stage in which exploration was to be continued and the foundations of stratigraphic classification were to be laid. G. M. Dawson examined the area of the Bow and Belly rivers in Southern Alberta. He included the Lower Dark shales, Belly River, Pierre and Foxhills formations in the Cretaceous and the St. Mary's River, Willow Creek and Porcupine Hills beds in the Laramie. These studies were continued northward by J. B. Tyrrell into central Alberta. Recognizing

the somewhat different nature of the upper part of the section there he divided the Laramie into Edmonton and Paskapoo. In the north on Peace and Athabaska rivers R. G. McConnell found another section, requiring many new formation names. In the southwest Dawson recognized the coal bearing Kootenay formation.

In the following years more attention was given to economic studies. D. B. Dowling revised the lower part of Dawson's section of southern Alberta to Benton, Milk River, Pakowki, Foremost, Pale beds, and Bearpaw. He also studied other parts of the plains and several coal mining districts in the foothills. He used stratigraphy in a practical way, in the location of areas of coal bearing strata and in the study of the structure of gas fields. His important work on the water supply of southern Alberta had a stratigraphic basis. His knowledge of the succession, as well as of the structure, led to the exploitation of the Milk River sandstone as a water bearing stratum. W. W. Leach mapped the coal bearing and other formations of the Blairmore area. G. S. Malloch mapped the Bighorn coal basin, where the differentiation of some new formations was found necessary. So a complex classification arose in the course of exploratory and economic studies. It was, however, no more complex than the stratal succession which varies so markedly from north to south and from east to west.

More detailed work followed in a later stage of economic studies. More active and intensive exploration for oil and gas called for more detailed mapping and structural studies and therefore more precise stratigraphic criteria. In oil geology the reservoir rock is a porous layer at a definite horizon, the source rock bears a definite stratigraphic relation to it and any estimate of drilling depth to a productive horizon is as much a stratigraphic as a structural problem. Examples of work at this stage are G. S. Hume's intensive studies of potential oil and gas fields, B. R. MacKay's, J. A. Allan's and R. L. Rutherford's studies of coal fields, L. S. Russell's studies of the late Cretaceous and early Tertiary, R. T. D. Wickenden's foraminiferal studies and maps and reports by B. Rose, J. S. Stewart, J. McEvoy, J. D. MacKenzie, S. E. Slipper, M. Y. Williams, P. S. Warren, W. S. Dyer, J. A. Dresser, C. S. Evans, J. O. G. Sanderson, T. A. Link, P. D. Moore, D. L. Powers, B. F. Hake, E. M. Spieker, T. W. Stanton and many others. In local studies the most refined lithological data possible have been used. In all regional studies, however, and in some local studies it has been found necessary to use faunal and floral criteria. Therefore new faunas and floras have been sought and the known ones have been reinvestigated for their chronological value. Ten marine Cretaceous

faunas are now available for stratigraphic purposes. They are the *Aucella*, "*Astarte*" *natosini*, *Beaudanticeras affine* or *Deshayesites*, *Gastroplites*, *Neogastroplites*, *Barbatia micronema* or Dunvegan, *Prionotropis*, *Scaphites ventricosus*, *Inoceramus lundbreckensis*, and the Pakowki-Bearpaw. There are at least six nonmarine Cretaceous and early Tertiary faunas, the *Unio biornatus* or McMurray, the *Unio hamili* or Lower Blairmore, the *Unio dowlingi* or Dunvegan, the Foremost, the St. Mary's River or Edmonton, and the Upper Ravenscrag or Paskapoo. There are three known Cretaceous dinosaur faunas, the Belly River, Edmonton and Lower Ravenscrag or *Triceratops*. There are at least ten Cretaceous and early Tertiary floras, the Kootenay, Lower Blairmore, Upper Blairmore, Dunvegan, Milk River, Belly River, Whitemud, Lower Ravenscrag, Middle Ravenscrag and Upper Ravenscrag.

In the western part of the Canadian Cordillera, before 1882, some reconnaissance work had been done by A. R. C. Selwyn, G. M. Dawson and others. In addition Dawson had produced his important report on the Queen Charlotte islands. The Mesozoic section at Skidegate inlet was described in considerable detail and divided into the Lower Sandstones, Agglomerates, Lower Shales and Sandstones, etc. This good beginning was marred by one defect. The sandstones and shales conformably overlying the agglomerates were mistakenly considered to be the same as those in the Lower Shales and Sandstones division and their faunas were mixed as one fauna. This led to the confusion of Jurassic and Cretaceous faunas in British Columbia for many years and exact stratigraphic work was retarded. The error became gradually recognized and corrected through the studies of R. W. Ells, D. B. Dowling, C. H. Clapp, J. D. Mackenzie and others. In ascending order, the Jurassic was found to consist of argillites with Lower Jurassic fossils, agglomerates and tuffs, sediments with an early Middle Jurassic or Bajocian fauna, a thick section of agglomerates and tuffs, and, at the top, sandstones and shales with an early Upper Jurassic or Callovian fauna. This was interpreted to mean that there was a late Lower Jurassic (or very early Middle Jurassic) epoch of volcanic eruption, a later Middle Jurassic epoch of eruption and that by Callovian time volcanic action had ceased. A section studied by G. Hanson at Hudson Bay mountain was found to be very similar, but as the top and nontuffaceous member contained no fauna it was noted that the cessation of volcanic eruption could not be dated there-After a study of the Harrison Lake area in British Columbia and of other areas in the North American Cordillera C. H. Crickmay considered that these two epochs of volcanic eruption were general from

Alaska to California. He also showed that there was a third outburst in late Callovian time. So stratigraphic studies have led to the recognition and dating of three epochs of volcanic activity in the western part of the Cordillera in Jurassic time. If space permitted it could also be shown that stratigraphic studies have been used in the dating of igneous intrusions, ore injections and orogenic movements in the Cordilleran region. Field data and interpretations can be found in reports and papers of S. J. Schofield, R. A. Daly, R. W. Brock, J. D. Mackenzie, W. E. Cockfield, G. Hanson, V. Dolmage, C. E. Cairnes, H. G. Gunning, J. F. Walker, S. C. McCann, F. H. Kerr, C. H. Crickmay and others.

It must not be forgotten that behind all these stratigraphic studies has stood a vast amount of palaeontological work. In the past fifty years this has included monographs and papers by J. F. Whiteaves, W. J. Dawson, H. M. Ami, G. F. Matthew, L. M. Lambe, W. A. Parks, P. E. Raymond, E. M. Kindle, C. D. Walcott, W. A. Bell, M. Y. Williams, L. D. Burling, Charles Schuchert, J. M. Clarke, G. S. Hume, P. S. Warren, E. W. Berry, Miss A. E. Wilson, Miss M. A. Fritz, W. H. Twenhofel, A. F. Foerste, S. R. Kirk, T. H. Clark, H. W. Shimer, E. J. Whittaker, S. S. Buckman, L. F. Spath, C. H. Crickmay, G. A. Cooper, L. S. Russell, W. S. Dyer, R. T. D. Wickenden, C. M. Sternberg, J. B. Reeside Jr., Arthur Hollick, C. H. Kindle and others. E. M. Kindle has recently proposed a method of publication of fossils that should remedy the present cumbersome and unwieldy state of American palaeontological literature.

The study of sedimentation has led to a better recognition of nonmarine deposits and of the relations of marine faunas to bottom conditions. E. M. Kindle, R. C. Wallace and W. H. Twenhofel have made important contributions. Palaeogeographic maps have been drawn by Charles Schuchert, D. B. Dowling and C. H. Crickmay.

Mineralogy in Canada, 1882-1932

By T. L. Walker, F.R.S.C.

In considering the development of mineralogy in Canada it is somewhat difficult to fix the limits owing to very varying conceptions as to the boundaries of the mineralogical field. On June 7th, 1752, Guettard presented to the Académie Royale des Sciences his *Mémoire dans lequel on compare le Canada à la Suisse par rapport à ses minéraux.* The material, which had been given him by residents in Canada, was derived largely from the valley of the St. Lawrence, though there are many indications on the accompanying map of occurrence of minerals, rocks and fossils all the way from Labrador to Louisiana. Fine illustrations of proboscidian and of invertebrate fossils are shown in the plates. This report is one of the earliest to deal with the mineralogy of Canada.

In 1752 mineralogy in a general way covered a great field from which have later sprung a number of now distinct branches such as petrography, economic geology, crystallography, analytical chemistry and finally geology. Geology, though an old term, was first used in its present significance in 1778 by de Luc. In its earliest significance *geologia* was used as a synonym for jurisprudence. This general subdivision of the field might at first sight seem to indicate that there was little left to be called mineralogy. It is still used to indicate the study of minerals, their genesis, geometrical form, chemical and physical properties, distribution, molecular structure and their final alteration by chemical reactions, to form new minerals. In this sense the new sciences which have grown from the original mineralogical field may be for the most part regarded as mineralogical sciences.

In Canada before the founding of the Royal Society much pioneer work had been accomplished by men of eminence. Dr. John Bigsby in 1824 published an account of his mineralogical studies of Eastern Canada in which are found very precise data as to the distribution of many important and interesting minerals. Dr. James Wilson, a Scotch physician resident in Perth, Ontario, in the fine spirit characteristic of many physicians in his day, interested himself in the natural history of his adopted country. Apart from minerals collected by him and described by specialists, his collection now contained in the museum in Perth testifies to his enthusiasm in this field. Thomson, a Scotch mineralogist, published the original descriptions of perthite, bytownite and huronite. To How of King's College, Windsor, we

owe much of our knowledge of the minerals of Nova Scotia, particularly of the zeolites and of the rarer boron-bearing minerals found in the gypsum beds.

With the foundation of the Royal Society of Canada, Harrington, Chapman, Hoffman, Hunt and Haanel became charter fellows, being connected with the section including the exact sciences, as it was then thought that the principal affinities of mineralogy were with chemistry, physics and mathematics, rather than with the descriptive or natural history subjects.

Harrington, the beloved professor of McGill University, made many valuable contributions, especially on the chemical side of mineralogy. In his reports, contained in the annual volumes of the Geological Survey, Hoffman contributed more than any other mineralogist to the record of Canadian occurrences during the first half of our Jubilee period. Nicol of the School of Mining, Kingston, had an enthusiasm for his subject that made him the greatest collector of Canadian minerals of his time. It is a pleasure to record our appreciation of these three workers of former days. Johnston in his great work on Canadian Mineral Occurrences has made us all debtors, while the work of Graham and Poitevin on the mineralogy of Black Lake is regarded as one of the best publications in our field during the period under review.

Apart from publications of the technical branches of the Dominion and Provincial governments of Canada, our country is not rich in media for the publication of scientific results. Equally impressive is the general absence of special societies in the different fields. The Canadian research worker is usually in touch with such societies in the United States, Britain or Germany and too often his work is published abroad. There is a marked unwillingness to form small national scientific societies in special fields with struggling attempts to maintain journals which would be, for some time at least, quite limited in circulation. It would be quite misleading to judge of the progress in mineralogy in Canada by the character and number of papers published in Canada. A more correct picture would be obtained by an examination of the American Journal of Science, the American Mineralogist and the Mineralogical Magazine.

There has been in the fifty-year period under review, a very rapid expansion of the mineral industry as shown by an output of ten and a half million dollars in 1886 with a gradual increase to a maximum of three hundred and ten millions in 1929. Mining has brought into commercial prominence minerals which fifty years ago would have been regarded as of only academic interest. The many arsenides of

cobalt, nickel and iron occurring with the silver minerals at Cobalt, the nickel and platinum minerals at Sudbury and the tellurides of the precious metals at Kirkland Lake and Porcupine, which at an early date would have received little attention, are now minerals of great economic importance. At the present time the tellurides are being studied largely with a view to the solution of problems connected with the recovery of the precious metals which they contain. As a preliminary to success, an effort is being made to fully differentiate and describe the mineral species present in the ore. The progress in mining is in our time as in former periods one of the strongest influences toward research in mineralogy. On the other hand the progress of mining has been aided by the work of the mineralogist who has devised methods to solve the problems of the practical man. This is well shown by the rise of a new branch known as mineralography which has shown how to use the microscope on polished surfaces and to indicate the character of the opaque ore minerals present with a precision comparable to that attained by the petrographer in the study of thin transparent sections of rocks.

Mineralogy has made an important contribution in the part taken in the training of engineers and geologists to carry out explorations and development of the country. When our society was founded men for this type of work generally went abroad to be trained either at Freiberg in Saxony, the Royal School of Mines in London or Columbia College in New York. At that time the superintendents and engineers of mining companies were commonly brought from other countries owing to the lack of men trained in Canada. In contrast to this stands the fact that in the large and varied mineral industry of to-day men of Canadian birth and Canadian training commonly hold the most responsible positions. In this change mineralogy in common with other branches of science has had its part.

Microscopic petrography which was begun by Sorby and developed in Germany, France and Britain was almost unknown in Canada in 1882. To-day it has become a method commonly used by most geologists and many engineers for the solution of their problems. In the meantime workers in this new field have not only used this method in routine work but have conducted researches of general interest to science and in some instances made important contributions. This is particularly the case in the work of Adams and Barlow in their report on the Bancroft area and in the studies by others in the Sudbury district and in the Monteregian Hills of Quebec.

In the establishment of well equipped and well staffed departments of Mineralogy in the Canadian Universities, new and old, a great

advance has been attained. The personnel of these departments are free to follow pure science and to conduct researches which may have no immediate economic or industrial bearing, but which in some instances may form the foundations on which at a later date important applications may be based. The great addition to the numbers of teachers and research workers has made it unnecessary for students to study abroad except to follow some very special course or with a view to securing greater breadth which comes from contact with masters of their science in many lands.

In the establishment of well ordered scientific collections and museums of mineralogy progress has been made. To Dr. W. F. Ferrier much credit is due for his enthusiasm in assembling and arranging fine collections in the Universities of Manitoba and Alberta. He also sold a collection to McGill University and another to the University of Toronto. The latter formed the nucleus around which the collection of the Royal Ontario Museum of Mineralogy has grown. The mineral collections of the Geological Survey of Canada have been incorporated into the National Museum in Ottawa. It is unfortunate that the National Museum has not a suitable museum building where its very valuable and extensive collections can be adequately displayed.

In the field of descriptive mineralogy there has been marked progress. While E. S. Dana in his System of Mineralogy, 1892, lists some 824 known mineral species, there have been added from Canada alone in the last forty years between twenty and thirty new species not previously known to science. The following incomplete list contains the more important new species:

Baddeckite
Calciosamarskite
Camsellite
Chapmanite
Chemawinite
Collinsite
Echellite
Ellsworthite
Ferrierite
Ferrisymplesite
Hastingsite
Hexahydrite
Hyblite
Lyndochite
Michel-Levyte
Spencerite
Sperrylite
Temiskamite
Thucholite
Toddite
Uranothorite
Violarite
Yukonite

For many previously known species much work has been done in supplementing the chemical, optical and crystallographic data and in adding to our knowledge of geographical distribution and conditions of genesis. Special mention should be made of the studies of the great variety of rare minerals which are found in pegmatite dykes. This is

largely the work of Dr. H. V. Ellsworth of the Geological Survey of Canada, though in some measure of Professor A. L. Parsons and the writer. Most of the work of Ellsworth has been published in the American Mineralogist while that of the other workers mentioned is found in Contributions to Canadian Mineralogy as issued annually by the University of Toronto since 1921. These rare pegmatite minerals are frequently chemically very complex, and are often marked by the presence of titanium, thorium, niobium, tantalum, uranium, zirconium and sometimes by a variety of so-called rare earths in addition to commoner mineral constituents. From the chemical data it is sometimes possible to determine the age of the minerals and of the rocks in which they occur. As a result we now know the relative succession in the earth's crust of some rock masses, quite apart from the method for fixing the order of formation as is done on palaeontological evidence by geologists. By the application of this new method it is now settled that the Grenville rocks are at least from one thousand to twelve hundred million years old, while in the case of certain pegmatites north-east of Winnipeg near the Ontario-Manitoba boundary, an analysis by Ellsworth of uraninite found in the pegmatites indicates that these rocks are nearly two billion years old and thus among the oldest known portions of the crust of the earth.

A very fruitful study by Dr. D. E. Kerr-Lawson on the pleochroic haloes found in biotite gives evidence of a uniform rate of disintegration of uranium throughout geological time, and under very varying conditions as to temperature and pressure. This work is of great importance in considering the age and the interior conditions of the earth.

In the study of minerals by means of X-rays Canada lags behind. Very few contributions have been made in this field and most of those published are based on studies in foreign laboratories. It is unfortunate that no mineralogical institute in Canada has as yet been able to secure the necessary equipment for this work. Chemists and physicists often have such equipment but so far they have not turned their attention to the study of the molecular structure of minerals.

In conclusion it seems evident that during the time that has elapsed since the founding of the Royal Society of Canada, there has been a marked advance in our knowledge of mineralogy and that the advance in Canada has kept pace with the work done in other parts of the world. Mineralogists have taken part in the stock-taking and cataloguing of our mineral resources, have assisted in the training of geologists and engineers, and have made an important contribution to the general advance of the subject, the results of their work having a philosophical bearing on some of the great questions of science.

The Development of Zoology in Canada, 1882-1932

By Arthur Willey, F.R.S.C.

The foundation year of the Royal Society of Canada coincided with the birth of a new era in zoology. In that year were revealed to an incredulous world the paintings on the wall of the Altamira cavern, demonstrating the continuity of art from the childhood of man to the age of Pericles. The prehistoric pictures of animals belong to the history of zoology, the painters and gravers to the history of anthropology, It may be that in time to come the present jubilee year will symbolize the resurrection of another phoenix of more brilliant plumage from the grey ashes of the past.

The achievements of fifty years in the scientific life of the Dominion of Canada, even in the restricted field of zoology, cover so much ground that the present review can only deal with vague generalities, not forgetting the "Fifty Years of Canadian Zoology" which formed the subject of Professor J. Playfair McMurrich's presidential address in the fourth section (1917: Trans. Roy. Soc. Canada, vol. XI, third series). The first president of this Society, Principal Sir William Dawson, was professor of "Things in General" within the domain of natural history at McGill University. He represented the transition from the school of collective culture to the ultra-specialism of to-day, which is splitting the society up into an ever-increasing number of sections, a process of segregation necessary for the advancement of science in any direction.

The first branch of zoology is that to which the name "bionomics" has been given. In its more primitive and practical aspects it prescribes the rules for the tracking and trapping of game. These rules are partly instinctive in the mind of the hunter, partly transmitted by oral tradition, and while they do not require any knowledge of books, they are the fruit of prolonged observation and wide experience of habits and haunts and woodcraft generally. Bionomics is the science which began aboriginally with hunting and fishing, then proceeded as a side-issue to domestication, and ended, often too late, with conservation. The Royal Society of Canada, through the example and initiative of its fellows and through the spirit pervading its meetings, has been instrumental in procuring substantial advances in the all-important field of conservation and in contributing its share towards that greater ideal whose aim is the preservation of the Fauna of the British Empire. The late Gordon Hewitt's book on

"The Conservation of the Wild Life of Canada" (1921) was a milestone in the story of the periodical fluctuation and progressive diminution of the game-resources of the country.

In this connection special mention should be accorded to the establishment of National Parks and Sanctuaries which have conferred incalculable benefit upon the Canadian Fauna, to the useful propaganda work accomplished by Bird Protection Societies, and to Mr. Jack Miner for his maintenance of the great refuge which he has created for the Canada Goose and other migratory birds on his estate at Kingsville, Ont. Mr. Miner is not only a protector of birds but a self-appointed executioner of those species which do not come up to his standard of Bird Behaviour. On this subject opinions differ and reference may be made to a pamphlet issued recently by the Brodie Club of Toronto. Moreover it should not be forgotten that the Accipitres are birds of prey by the grace of God.

In G. H. Blanchet's report on the "Keewatin and northeastern Mackenzie" (Department of the Interior, Ottawa, 1930) the late Mr. John Hornby is cited as holding the theory that the presence of wolves was a benefit to the caribou herds in killing the old and the unfit. This is in agreement with George Catlin's observations on the relation existing between wolves and bison herds in the old days. Again sportsmen in India put tigers into three classes: game-hunters, cattle-killers, and man-eaters. Those in the first class constitute the majority and they are described by G. P. Sanderson ("Thirteen Years Among the Wild Beasts of India." Edinburgh, 1912) as being not only exceedingly inoffensive but beneficial in keeping down the herds of deer and pig that would otherwise destroy the crops of the ryots. The Hornby Theory then was not so "unusual" as it might appear to be on the surface. It is of melancholy interest to add that the scene of the Hornby tragedy was re-visited by Mr. W. H. B. Hoare in 1929, as detailed in his report on "Conserving Canada's Musk-Oxen" (Department of the Interior, Ottawa, 1930).

The conservation of fishery resources presents problems quite different from those which have to be met and solved in the protection of fur and feather. The catching of fishes on a commercial scale, landing them, preparing them for the market, transporting them to distant distributing centres, and retailing them to the consumers, all these and other necessities of manipulation, where science, industry, and politics meet on common ground, are cared for by the Biological Board of Canada and the stations under its control on the east and west coasts, as well as by various provincial departments. The history of the Biological Board and of the international status to

which it has attained chiefly through the energy and zeal of Dr. A. G. Huntsman is intimately bound up with the fellowship of this Society. According to the Rev. G. W. Taylor ("A Plea for a Biological Station on the Pacific Coast." Trans. Roy. Soc. Canada, 3rd series, vol. I, 1907) the movement for the creation of biological stations "owed very much to the efforts and influence of the Fellows of the Royal Society." One need only mention the names of E. E. Prince, R. Ramsay Wright, D. P. Penhallow, A. B. Macallum, and J. P. McMurrich, to realize the truth of this statement.

The second branch of zoology which has been encouraged in due proportion by the Royal Society of Canada, is taxonomy; it is also the saddest, since the original simplicity of the Linnaean System has fallen into inextricable confusion through the setting up of rival names for the same generic types and specific forms. This competitive nomenclature began at once after the release of the new method of naming, and it is now a great part of the life-work of systematists to sort out the names according to rules of priority without regard to long-established conventional usage. Committees have been appointed to consider questions of priority, but they have consisted wholly or in main part of purists and specialists, not sufficiently representative of reasonable authority. A single example will make this clear. In an important monographic treatise on "Locusts and Grasshoppers" by B. P. Uvarov, published by the Imperial Bureau of Entomology in 1928, an account is given of the life-history of blister-beetles of an Old World genus conventionally named *Mylabris*. On escaping from the egg, the newly hatched larva at once runs rapidly over the ground, entering crevices in search of the egg-pod of a grasshopper into which it makes its way. It then moults into a second larval form and feeds upon the eggs. It goes through other transformations and finally emerges as the perfect insect only to find that it is no longer to be called *Mylabris*; but of this sudden change of patronymic there is no hint in Mr. Uvarov's book.

The third branch is morphology which seeks to interpret the forms of animal life, distinguishing between equivalence of parts due to genetic affinity or ancestral history, and similarity of parts due to sameness of function. This subject also has been taken under the broad wing of the Royal Society in spite of its lack of general appeal. All research and speculation along morphological lines since 1882 have been influenced, directly or indirectly, by the work and example of Francis Maitland Balfour, who was killed by a fall in the Alps in that year. The same year witnessed the passing of Charles Darwin,

author of the Selection Theory of Descent; and of Theodor Schwann, announcer of the Cell Theory of Organization.

"The first died in his prime, the other two
Lived till they'd travelled art and nature through."

The fourth and latest branch to be mentioned here is Ecology. This is the science of life which considers the species of animals and plants in their totality, in conjunction wth the physical and organic environment. However strenuously a species may strive to escape from its environment, as a mole fleeing from the light or a lotus rising from the mud, it is compelled to retain many contacts with it. The distinction between ecology and bionomics is rather ill-defined. Perhaps it may be expressed as follows. Bionomics is concerned with the individual behaviour of animals, whether free-living or parasitic, in their immediate environment; ecology studies the mass effect of the environment upon the collective animal and plant life in a given area. Ecology deals with landscapes, abundance, injury to crops, migrations, and distribution; bionomics pays attention to means of concealment, care of young, symbiosis, home-range, and food-getting.

The activities of the Entomological Branch of the Department of Agriculture should be specially signalized by reason of the great extension of its field-work under the successive Dominion Entomologists: James Fletcher, C. Gordon Hewitt, and Arthur Gibson. Probably the most significant single discovery has been that made by Dr. E. M. Walker of the Rocky Mountain Roach-cricket, named by him *Grylloblatta*. It is a new annectent type, having the limbs of a cockroach and the ovipositor of a cricket.

Finally, there have been a number of collecting trips into the wilderness and exploring expeditions have been sent out at various times, chief among them being the Canadian Arctic Expedition (1913-18). These have enriched the body of Canadian zoology beyond comparison with earlier records. During the memorable years under review an astonishing wealth of zoological observation has accumulated. These results have been accomplished by individual initiative supplemented by the close affiliation of the Universities and Government Departments with the Royal Society.

Progress in Fisheries Research in Canada

By A. G. Huntsman, F.R.S.C.

On May 6, 1895, Professor A. P. Knight addressed a letter to Sir John Bourinot, the Secretary of the Royal Society of Canada on the subject of a Marine Biological Station, and through the efforts of the Society and of the British Association for the Advancement of Science, which met at Toronto in 1897, such a Station began operation at St. Andrews, New Brunswick, in 1899 under a Board of Management consisting of representatives of universities and of the federal Department of Marine and Fisheries. From this beginning there developed the Biological Board of Canada, now operating four main Stations and three sub-stations on the Atlantic and Pacific coasts, with a permanent scientific staff engaged in research, and with many seasonal investigators from the various universities.

Nearly eight hundred separate articles have been published in connection with the work accomplished at the Stations of the Board, starting with the first issue of Contributions to Canadian Biology in 1901 (See List of Publications—1901-1921, Contr. Canad. Biol., 1921, no. XII; and List of Publications—1922-1930, Bull. Biol. Board Board Can., no. 28). This represents the labours of more than one hundred and fifty different investigators, most of whom have been from the various Canadian Universities, nearly all of these being represented in the list. Thus has been accomplished the object for which the first Station was started,—to permit Canadian scientists to conduct investigations which would lay the foundations for scientific administration and conduct of the fisheries of the Dominion. This has been made possible through the increasingly more rapid development of scientific research in our universities, so that although one of the last countries to definitely undertake fisheries investigation Canada may now well be said to be in a number of directions in the forefront of such work among the nations of the world.

While the primary object of the many investigations has been to gain an understanding of the life in the sea and other waters, and to further its best utilization by man, the work has not been, and could not properly be, limited to the biological field, but has included related fields in the other sciences, such as the physics and chemistry of the sea. Also work has been necessary in nearly all subdivisions of the field of the biological sciences,—botany, zoology, taxonomy, ecology, anatomy, embryology, pathology, bacteriology, physiology, and biochemistry. The many problems are so diverse and have so

many aspects that their solution requires the bringing in in turn of investigators using most diverse methods of approach.

During the first part of the period investigations of the fauna and flora occupied a very prominent place in the work, and nearly all groups of animals and plants were studied. Much continues to be done in this field, but the paucity of investigators in comparison with its extent has not permitted the laying of more than a part of the foundation of knowledge in the systematics and distribution of aquatic life, that is so necessary for studies in the other fields. Very considerable assistance has been obtained from the scientists of other countries, particularly of those in the United States. Only the veriest beginning has been made of a comprehensive account of the Canadian Atlantic Fauna, a series which it is planned to duplicate for the Pacific coast.

A knowledge of the physical environment for the aquatic life, that is of the hydrography of the waters, has been building rather steadily, starting with the masterly survey by Dr. Johan Hjort of Norway and his associates of the Atlantic Coastal waters in 1915 (Canadian Fisheries Expedition, 1914-15). There has in recent years been a lag in work in this and the closely allied field of deep sea fisheries in spite of the interest maintained through the North American Council on Fishery Investigations. Revival is, however, taking place through the demands that are being made for investigations of the fishery resources and for explanation of the fluctuations in the deep sea fisheries. Also investigations of the oceanography of the waters of the bay of Fundy have delineated the problem of the production of the exceptional fisheries near the mouth of that bay, and the conflict of power and fisheries interests has resulted in an international investigation of the problem, now in progress. This general problem of the mechanism of fish production has stimulated research in the last few years on both coasts into the chemistry of the sea in relation to plant growth. This is one aspect of the broad, and most important question of the limiting factors for aquatic life. During the last decade quite a large number of investigations have been reported bearing upon this question, which has its beginnings in studies of the distribution, and of the peculiarities in the environment, of the various forms of life, but which requires physiological and biochemical study for elucidation.

Outstanding have been the investigations of the life histories of important economic species of fishes. None has evoked more interest than the sockeye and other salmon of the Pacific coast, which appear in extremely variable, sometimes enormous, numbers. Approximately

half of a twelve-year experiment to test the comparative effectiveness of different breeding procedures for the sockeye salmon has been carried through. This has been but part of a rather comprehensive attack on the whole problem presented by fish culture, as conducted by governmental agencies, that has been in progress for nearly ten years, and that has involved general investigations of many inland waters, so far only partially reported. Here also study of the limiting factors for fish life is important for an understanding not only of the conditions in nature but also of those in cultural operations, where unfavorable physical conditions become evident in the appearance of disease or in the summary death of the fish.

As preventive measures against disease are used in preference to curative ones, for fishes, study of causative organisms has not developed to any extent, and bacteriological investigations have chiefly involved those forms found in the sea and in fishes after death. Quite extensive studies have been made of the bacteria causing decomposition, starting with work by Dr. F. C. Harrison at St. Andrews in 1915. This work has become definitely related to a comparatively new development,—the establishment of Fisheries Experimental Stations (one on each coast, in 1925 and 1926) for a definite attack on the problems presented in the handling of fish for food. Bacteriologists, biochemists, chemists, and physicists have been conducting fundamental researches in relation to the holding, freezing, salting, drying, smoking, and canning of fish, an almost virgin field. Basic, however, for such work is the knowledge that has been, and is being, gained by investigators from the universities, that have been studying the histology and various aspects of the biochemistry of fish muscle, the latter being linked up with muscle physiology and carbohydrate metabolism.

The picture that the history of the Biological Board presents is one of the growth of a very effective organization for forwarding researches, that are graded from the fundamental, which are of broad (and often not readily recognized) application, to the practical, which are of particular and obvious (though restricted) application, and that are all related to the fisheries. The effectiveness of the organization in comparison with what exists in other countries would seem to be due to the semi-independent character of the Board, and to its definitely combining through its membership the diverse viewpoints of scientific investigators, administrators and industrialists. Although opportunities for them exist, investigations of a general biological nature unrelated to the fisheries have been carried on at the Stations of the Board only to a very limited extent.

The Development of Physiology and Biochemistry in Canada

By A. B. Macallum, F.R.S.C.

Before 1880 the Sciences of Physiology and Biochemistry as we now understand what they comprehend were not recognized as such in the Universities of Canada. In some and also in the then proprietary Schools of Medicine physiology was taught in a stepmotherly fashion by medical lecturers who had no first hand acquaintance with the science. In one it was classed with Histology and Pathology, as the Institutes of Medicine, the Chair of which, in McGill University, was held from 1874 to 1885 by Dr. (afterwards Sir) William Osler who threw into his teaching of this subject a personal element which characterized all his later career as Professor of Medicine. Even in the Universities of the United States Physiology was given scant attention and it was only in Johns Hopkins University under Professor H. Newell Martin (1876-92), an outstanding experimentalist at that time, and in Harvard University under Professor H. P. Bowditch (1876-1906) that the Science was accorded a recognition that measured up to its achievements in the Universities of Europe.

In Canada the advancement of the science began in 1885 when the writer, a student of H. Newell Martin, introduced in the teaching of medical students the modernized type of physiology, all under the influence of R. Ramsay Wright, an outstanding exponent of Biology in the University of Toronto from 1874 to 1912. In 1887 the course in physiology was patterned after that in Cambridge under Sir Michael Foster, under whose auspices the school of physiology there rivalled that anywhere else on the continent. As a result in the succeeding twenty years a number of physiologists were trained, of whom three occupy chairs of the subject in universities in the United States, one in England and one in Canada, all of whom have made, by their experimental investigations, noteworthy contributions to the knowledge of the subject. The one in Canada, Professor F. R. Miller, devoted his studies to the functions of the Nervous System and especially the localization of the salivary secretion and cardio-inhibitory centres and to studies of the various Reflex Actions of the Nervous System. He has made fundamental studies on the physiology of the cerebellum. All these contributions have brought him this year the distinction of being elected a Fellow of the Royal Society of London.

In the other Canadian Universities the Chairs of Physiology are held by able exponents of the subject and they have made their contributions to the subject. In McGill University, besides Dr.

John Tait, Head of the Department, there is Dr. Boris Babkin, the Research Professor of Physiology, a former student and assistant of Dr. Ivan Pavlow the veteran and renowned Professor of Physiology of Leningrad (Petrograd, Russia). He and a number of his research students have contributed in the last few years a number of papers which have appeared in the Transactions of the Royal Society of Canada, mainly on gastro-intestinal physiology.

The science of Biochemistry is of more recent origin than Physiology. The latter began with Harvey (1578-1657) and Mayow (1642-1679) and Johannes Muller (1801-1858) whereas Biochemistry began to be specially a field of research after 1875 when it was called Physiological Chemistry, a designation contested in the early "eighties" by physiologists who held that the subject covered should be regarded as belonging to Physiology and by chemists who maintained that it was but Organic Chemistry. Its development as a broad science, however, proceeded at first slowly but after 1900 rapidly, and was then acquiring also the title Biochemistry which is now current in England, Germany and Canada. Now the number of separate contributions to the literature of the subject, which in the early "eighties" did not number more than one hundred and fifty, annually exceeds each year more than four thousand, and the achievements from research in it have been and are of outstanding importance, not only in explaining many of the chemical processes by which living matter carries on but also in furnishing methods and products of service in the diagnosis and treatment of a number of diseases.

In Canada Biochemistry began to be taught in 1884 in the undergraduate courses in Medicine and Arts in Toronto but it was only in 1888 that it began to rank with physiology in the extent of the instruction involved. In 1908 it was created a separate Department under a Professor who had to give all his attention to the subject in the undergraduate courses in Arts and Medicine as well as in the postgraduate courses which involved research as an essential requirement. In McGill University Physiological Chemistry was taught by the late Professor R. F. Ruttan, an exemplary exponent of the subject from 1892, but only as an undergraduate course in Medicine which it continued to be till 1920 when it began to rank as a major subject for the Ph.D. degree in the Faculty of Graduate Studies. In the other leading Universities in Canada Chairs of Biochemistry now obtain under which extensive courses in the subject are given and which involve a certain amount of research by the holders of the Chairs and their assistants. This indicates the rank that is now accorded, in Canada, to Biochemistry which, fifty years ago, in

Europe, was in many universities denied a rank as a distinct science.

Not a few of the achievements of this science in Canada since 1882 have been noteworthy. Only a number of these, for want of space, can be specified. Among these are (1) the ascertainment of the distribution of the inorganic elements in animal and vegetable cells and tissues, (2) the origin of haemoglobin in the erythroblasts in vertebrates, (3) the place and mode of origin of the hydrochloric acid in the peptic glands, (4) the indication that the blood plasma in its inorganic composition is but a hark-back to the ocean water of about seven hundred million or more years ago, which was the first circulatory fluid of living organisms and especially of the very earliest progenitors of the vertebrates of that time, (5) the discovery of the method of extracting from the pancreas the "hormone" insulin, formed by the Islets of Langerhans in this organ and which controls the metabolism of sugar in the body, the failure of the Islets to secrete which causes the more or less grave condition known as diabetes mellitus. The discovery of the method of extracting insulin by a Toronto group (Macleod, Collip, Banting and Best) an achievement of signal distinction, has placed at the service of medicine, everywhere, a mode of treatment of diabetes which, while not curative, is so far ameliorative as long as insulin is administered to them as to relieve diabetics of the serious conditions of the disease and to prolong their lives. A number of contributions on this subject have appeared in the Transactions of the Royal Society of Canada.

There is also the achievement (Collip) of the discovery of a "hormone," parathyrin, formed by the parathyroid glands, which controls the calcium content of the blood and which is markedly ameliorative when given to patients suffering from tetany in which the concentration of the calcium in the blood is below the normal.

It may be added that on the subject of the vitamins, research on which now engages the activities of a host of workers, some of the earlier investigations from 1912 to 1918 included a number by a Canadian who, at first in the Lister Institute in collaboration with C. Funk, and later in Toronto, by researches, helped to pioneer in this line.

From the foregoing account it may justly be concluded that Canadian physiologists and biochemists have in the last fifty years played a noteworthy part in advancing their sciences.

The Development of Pathology and Bacteriology in Canada During the Last Fifty Years

By James Miller, F.R.S.C.

Restriction within the limits of a thousand words precludes any adequate discussion of this subject. If the author has confined himself to the doings of those who have passed on and to the senior men in the sciences his apology to the rising generation of pathologists and bacteriologists in Canada is that they will receive their recognition in due season. All methods of classification have their disadvantages; the territorial one which has been adopted is perhaps as good as any.

The science of Pathology, although in reality as old as Medicine, became separate and distinct as a subject in the teaching schools only towards the end of the nineteenth century. Its sister science of Bacteriology is of still more recent growth. Both have reached maturity within the period under review.

The first Canadian chairs of Pathology were founded simultaneously by McGill University and by Toronto in 1892, but even before this date excellent work was being done in the subject, notably by William Osler. Osler was appointed to the Chair of Institutes of Medicine in McGill in 1874. During the following twelve years he was engaged primarily in teaching Physiology, but it was customary at that time to combine the teaching of this subject with that of Pathology and for this purpose he voluntarily undertook the autopsies at the Montreal General Hospital. His original work during these years, as indeed throughout his life, was largely in the realm of Pathology. Among many of his contributions the conspicuous one of the Montreal period was his work on Malignant Endocarditis, delivered as a course of lectures before the Royal College of Physicians of London (1885). In Comparative Pathology, during his stay in Montreal Osler published important work on hog cholera, bovine tuberculosis and animal parasitic diseases.

On Osler's transference to Philadelphia Wyatt G. Johnson took over the teaching of Pathology at McGill. He made a contribution to our methods for the diagnosis of typhoid fever. In 1892 J. George Adami was made the first incumbent of the Chair of Pathology at McGill, and throughout his tenure of office (1892-1919) he exercised a dominant influence over the science of Pathology on both sides of the Atlantic, largely through his widely read text-books. A list of Adami's original contributions to Medicine would occupy many pages. His successor, Horst Oertel, is well known for his work

on Bright's Disease and Nerves in Cancer, and for his text-books. He is distinguished among teachers of the subject on account of his philosophical outlook.

At the University of Montreal a Chair of Pathology was founded in 1894. The present occupant is Pierre Masson, who was appointed in 1926, coming to Canada from France. His work on tumours in general and melanotic growths in particular, and also his original staining methods and colour photomicrographs, have attracted the attention of the entire pathological world. He is the author of a work on practical pathology written in the French language.

Among Toronto pathologists the first name deserving of special mention is that of J. J. Mackenzie. He held the Chair of Pathology in the University of Toronto from 1900 till his premature death in 1922. Of Mackenzie's contributions to science his work in association with T. G. Brodie, on the structure and function of the kidney glomerulus, published in the Transactions of the Royal Society of London, deserves notice. Oskar Klotz followed Mackenzie at Toronto. He has made outstanding contributions to our knowledge of arterial disease and fatty and calcareous degeneration. More recently his work on Yellow Fever has drawn attention to him as a courageous man and an able scientist.

A Chair of Pathology was first founded at Dalhousie University in 1911, M. A. Lindsay being the first occupant. His promising career was tragically cut short in 1914. A. G. Nicholls, who followed Lindsay, is well known for his collaboration with Adami in his text-book and for his work on Multiserositis. In his present capacity as editor of the *Canadian Medical Association Journal* he is contributing reviews and editorials of importance. Ralph P. Smith, the present occupant of the Chair, is known for his work on Typhoid Carriers, written for the British Medical Research Council.

The University of Manitoba has had a Chair of Pathology since 1916. The first and present occupant is William Boyd, who has done original work of great merit on gall bladder disease and on Epidemic Encephalitis. His text-books on surgical and medical pathology have made the author one of the best known pathologists of the day.

Queen's University, Kingston, has possessed a Chair of Pathology since 1895, the first occupant being W. T. Connell, who did excellent work on the bacteriology of milk and cheese as well as on the morphology of the tetanus bacillus. Since 1920 the post has been held by James Miller, who has contributed work on liver atrophy, the histology of tuberculosis and neoplasms.

Any account of pathological work done in Canada would be incomplete without reference to Maude Abbott, Assistant Professor of Medical Research at McGill University. Dr. Abbott is well known throughout the medical world for her investigations of congenital diseases of the heart. She is, moreover, the founder and present secretary of the Association of Medical Museums, a world-wide society concerned with all matters connected with pathological museums. Under the auspices of the association Dr. Abbott edits a Bulletin published at intervals, dealing with technical methods.

Bacteriology, one of the youngest of the sciences, has been until the last few years for the most part a department of Pathology. Separate chairs now exist in a majority of the Canadian Universities. Work of outstanding merit has been done on streptococci by W. L. Holman of Toronto; on the cultivation of vaccinia virus by H. B. Maitland, formerly of Toronto, now of Manchester University, England; and on the types of tubercle bacilli isolated from diseased tissues, by G. B. Reed, Kingston. E. G. D. Murray, recently appointed at McGill University, is noted for his work on the types of meningococci; and A. Rankin, of Alberta, has contributed to our knowledge of the use of B.C.G. vaccine in cattle.

In the realm of Immunology J. G. FitzGerald and D. T. Fraser, of Toronto, are widely known for their work on scarlet fever toxin and the use of toxoid in the prophylaxis of diphtheria.

Canada has always exported of her best and it is noteworthy that W. G. MacCallum, of Johns Hopkins University, well known for his text-book and for many contributions to the science of pathology, and F. D'Herelle, professor of Bacteriology in Yale University, the original worker on bacteriophage, are both by birth Canadians.

Summing up the situation, one may say that Canada has at least done her share in the development of these two sciences during the last fifty years, and there is ample evidence from the work of the rising generation that in the time to come she will enhance her already high reputation. Most of those who are mentioned above are or have been Fellows of the Royal Society and although little of their work has in past years appeared in the Transactions an ever increasing number of communications which are presented at the meetings of the Society are pathological in nature.

Clinical Medicine and the Royal Society

By J. C. Meakins, F.R.S.C.

The foundation of the Royal Society of Canada roughly coincided with that period in the development of medicine when certain branches of the pure sciences were beginning to make themselves felt in the elucidation of disease processes. Cellular pathology under the great stimulus of Virchoff and his school had made certain important advances and it was at this time that bacteriology was in its infancy. It was therefore but natural that at this period any members of the Royal Society who were medically inclined were either anatomists, pathologists, or bacteriologists, and at that time these were mostly recruited from the ranks of the medical profession. A good example of this combination was the eminence to which the late Doctor Francis Shepherd reached in the study and teaching of anatomy.

As time passed the practising physician or surgeon assumed a much less important role in those branches of medicine which were chiefly devoted to original investigation of a purely scientific nature. Therefore, instead of their being numbered amongst the members of the Royal Society as such, their places were gradually taken by the pathologists, the bacteriologists, physiologists, biochemists and pharmacologists. This evolution naturally led to a considerable increase in the membership of those of the medical profession who, although not practising physicians, were interested in the development of the Royal Society. This would appear to be reflected in the establishment of Section V, devoted to the biological sciences, which occurred in 1918. During the life-time of this Section there have been four Presidents who have had medical degrees and it is interesting to note that these have all held office in the last seven years. None of them could be said to devote himself to medicine as such but were solely occupied in the biological sciences which have a bearing on this subject. Furthermore, the lack of influence which the Royal Society might exert upon the science of medicine is emphasized by the fact that there is only one member of Section V who is devoting himself to experimental medic ine. Medicinehas given many men to the biological sciences, but now as she is evolving into an experimental science herself it is but natural that she will retain many of these within her own fold. Therefore, it is to be expected that in the near future not only will experimental medicine be able to give to the Royal Society but also the Royal Society will have it in its power to do much to encourage this development.

A Sketch of the Past Fifty Years of Canadian Botany

By R. B. Thomson, F.R.S.C.

The history of Canadian Botany up to 1895 has been dealt with in a most thorough manner by Penhallow—in two articles published in the Transactions of this Society. The landmarks in the earlier part of this history are all of foreign origin: the publication in Paris by Jacques Cornut of *Canadensium Plantarum* in 1635; the visit in 1749 of Peter Kalm, a Swede and pupil of Linnaeus, whom Penhallow refers to as "the Father of Canadian Botany;" the publication in 1803 by André Micheaux of *Flora Boreali Americana*, the first botanist to determine the northern limits of many of our forest trees; and in 1840 the publication by Sir William Hooker of his *Flora Boreali Americana* which included plants from several Arctic exploration parties. Mention should also be made of Archibald Menzies' work (1792) on British Columbia plants, as up to his time exploration had been confined to Eastern Canada.

Towards the latter part of this early period, from 1850 on, Canadian botanists began to take a major part in the development of the subject. Their activities centred chiefly in the Universities and in various Government Departments, Dominion and Provincial. The first and most outstanding of the names of these Canadian pioneers is that of Dawson, who began his work with the Geological Survey, first contributing to a knowledge of the living flora of Canada and later bringing Canada into prominence in the field of fossil botany by the number and importance of his publications. In connection with his work I might mention one thing in particular which is a source of pride and pleasure to Canadian botanists. It is the demonstration of the scientific value of Dawson's original work on Psilophyton (from the Gaspé Peninsula), by the recent investigators of the related primitive vascular plants from the Rhynie beds of Scotland. Other names that should appear in the roll of honour of Canadian pioneers are Bell and Lawson. The former's map of tree distribution, made in 1880, still stands with minor alterations as the standard for Canada. Lawson's list of publications, especially on Canadian flora, is a long one—second only to that of Dawson, and of no inconsiderable value.

When the Royal Society of Canada was founded in 1882 there were thus two lines of botanical work well under way. That the first President of this Society should have been the man who was making Canada known in the field of fossil botany is significant of the interest

in this phase of botany at that time. In the other field, that of systematic botany, a figure that was to be a dominating influence for many years was just beginning publication. It was in 1883 that Macoun started his Catalogue of Canadian Plants, which appeared in seven parts over the period 1883-1902, and which contains in all some 1700 pages, and is one of the most extensive and complete publications of its kind. Macoun was Canada's greatest exploring botanist covering vast areas by his indefatigable labours and making large collections of plants, over 100,000 of which are in the National Herbarium at Ottawa. To Macoun must also go the credit of drawing attention to the suitability of the prairie region of Canada for agriculture, a conclusion based on his phenological observations.

The botanical work of neither Dawson nor Macoun could be said to have been done with an economic purpose in view, and credit is due the Geological Survey for the broadminded policy which enabled such valuable pure science work to be done.

Of the contemporaries and successors of Macoun in the systematic field it was only his son James, whose brief career gave so much promise, who was of the exploring type. Others were interested in local floras or in special fields. Of these Fletcher (Flora Ottawaensis), Fowler (New Brunswick flora), McKay (Nova Scotia flora), Burgess (ferns), Dearness and Somers (fungi), and Hay (algae) are outstanding. To-day systematic botany of the higher plants is being carried on chiefly by Maltę, at the head of the National Herbarium, by Marie-Victorin and the workers he has inspired at the University of Montreal, and by Davidson of the University of British Columbia; algology in connection with the Eastern and Western Marine Biological Stations, and at the Universities of Manitoba and Dalhousie; and systematic mycology at the Central Experimental Farm and at the Universities of Toronto and Manitoba.

In connection with systematic botany herbaria have been built up at various places. The largest and most important collection of flowering plants and ferns is that of the National Herbarium. This was started under the auspices of the Geological Survey in 1882 by the purchase of Macoun's private collection, to which his later additions, as already noted, brought the number to upwards of 100,000 sheets. The number has now been increased to about 137,000. Ranking next to this is the collection of the University of Montreal with 75,000 sheets and an additional 60,000 in the private collection of Marie-Victorin. The Fowler Herbarium at Queen's University and that of the University of Toronto each contains over 30,000, while there are several others with 10,000 or over; of these that of

Acadia with the Hay's collection and Fernald's additions, and that of Mount Allison with Lawson's original collections might be mentioned. Of important mycological collections there are at least three: that of the Central Experimental Farm with about 35,000 specimens, brought together by Güssow and his associates; that of the University of Toronto which now numbers 30,000, exclusive of 10,000 Uredinales in Jackson's private collection—both of these being rapidly increased, the former in the course of a mycological survey of Ontario and the latter in connection with his valuable systematic publications on rusts; and the private collection of Dearness of London, numbering over 8000 species, with usually several collections of each which bring the total to about 30,000. A modern development, that of seed collections, has been initiated at the Seed Branch, Ottawa, and at the University of Toronto.

Before leaving this aspect of the subject it is pleasing to note that there is a growing interest in collections of living plants and that several large centres of population are seriously considering the establishment of Botanic Gardens. If there were not so many chances of failure I might mention some of these!

The beginning of plant oecology in Canada can be traced to the observations and notes on the distribution of plants, especially of trees, made by botanists attached to early exploration parties. Reference has already been made to the importance of Bell's map of tree distribution. Phenological observations, stimulated by McKay come next, their regular publication starting in 1900. Another phase of oecology was begun by Ganong in his studies of the coast vegetation of New Brunswick. Later Lewis and his co-workers shifted the centre of oecological work in Canada to Alberta, by their researches on muskegs and winter changes in leaves. This shift of centre, however, was not complete, as the work of Lloyd and Scarth on the destruction of bog forests and on the river bank and beach vegetation of the St. Lawrence forms a valuable contribution to Canadian oecology. Nor should a reference to the work of Fernald be omitted here. This distinguished botanist of the Gray Herbarium has continued the interest of its founder, Asa Gray, in the flora of Eastern Canada, and for over a quarter of a century has worked in this region and Newfoundland, establishing by his studies a most stimulating "relic" theory in explanation of the origin and distribution of the floras of Northeastern America.

There is a curious thing in connection with the beginning of morphology and anatomy in Canada. It would seem that such work was begun on extinct, fossilized plants instead of on the living forms,

since I can find no record of any work preceding that of Dawson. This somewhat anomalous situation was soon remedied. In 1883 Dawson secured the appointment of Penhallow to the staff of McGill and a volune of work soon appeared on the structure of North American living gymnosperms as well as on their fossil relatives. Slightly later Jeffrey started his structural studies at Toronto, which led him into a stormy field of dispute over his stelar theory. The warmth of his enthusiasm is probably responsible for the fact that morphology and anatomy of the higher plants continued to find a home at Toronto even after Jeffrey left for Harvard.

Studies on the morphology and biology of the lower non-vascular plants have been restricted almost completely to the fungi, and the work done has been chiefly at Winnipeg and Toronto. The outstanding contributions of Buller and his associates will stand for all time as a monument to Canadian mycology in its pure science aspect, while those of Faull and his co-workers at Toronto must be evaluated rather from their applied aspect, as basal to forest pathology.

In the development of plant physiology in Canada McGill has taken the lead from the beginning. Penhallow's original interest was physiology and after coming to Canada he continued that interest until about 1890, publishing on water and food relations and the mechanism of movement of plants. Subsequently little work of value appeared in this field until the appointment of Lloyd in 1912, whose work on stomata had won wide appreciation. Under his leadership the contributions have been numerous and varied—on abscission, colloidal properties of protoplasm, fluorescence of algae, conjugation of Spirogyra, tannin, mucilage, etc. Scarth's work on cellular and stomatal physiology has added to the supremacy of McGill in this field. The work on carbo-hydrates being carried on by Hibbert and that of Newton on winter hardiness of wheat are important from the standpoint of biochemical physiology. Recently at Toronto Duff has opened up a promising field of respiratory research bearing on ageing and disease of plants, and here also Sifton's work on the factors influencing seed germination is yielding important results.

Up to this point in our survey we have covered only pure science aspects of Botany. These were the first to receive attention in Canada, but very soon economic influences began to appear and make themselves felt. These influences may be said to have taken definite form on the passing in 1886 of the Experimental Farms Act, whereby the Central Experimental Farm at Ottawa and four Branch Farms in other parts of the Dominion were originally established, and later

others as necessity arose. The name of Saunders will always be associated with this forward step in the field of applied botany in Canada.

For some years previous to his appointment to the Directorship of the Farms, Saunders had been doing breeding work for the improvement of bush fruits and flowers. Naturally he carried this interest with him into his new position, where soon suitable material for extensive breeding was assembled and experiments started. The work on wheat was begun in 1888, by Saunders himself, and carried on and extended by his son Charles E., with the introduction of the varieties Marquis, Ruby, Reward and Garnet as the result. The two latter though named by Charles Saunders were tested and distributed by Newman. Breeding for the improvement of fruits, especially of the apple was also begun at the Central Experimental Farm, as soon as opportunity permitted. This work was continued and extended by Macoun after his appointment in 1897 as Dominion Horticulturist. Cereal work of great value was also carried out at the Ontario Agricultural College under the direction of Zavitz, whose varieties of barley and oats have proved of special value. At Vineland in the Niagara District there is considerable work being done on the improvement of fruits and flowers. Among amateurs there has been in recent years a marked interest in breeding work. The possibility of safeguarding the breeders' rights by "Plant Registration" will no doubt afford a stimulus to future work.

The theoretical side of plant breeding, plant genetics, is of very recent development in Canada, the work along this line having been done, either as a preliminary to or as a by-product of breeding for economic purposes. Although the work of Charles Saunders on inheritance of awns in wheat, published in 1904, is the first Canadian work of a purely genetic character, it is to Thompson and his co-workers at the University of Saskatchewan that we must give chief credit for its establishment and further development. In the West such work has centred around cereal breeding. In the East, McArthur, of the University of Toronto, has made a valuable contribution in his study of linkage phenomena in the tomato. The recent appointment of Huskins at McGill indicates the growing interest in this field.

Cytology has found its major field of development in Canada in connection with genetics and here again the University of Saskatchewan takes the lead. It is to be regretted that no other phase of cytological work is being adequately developed, although the work of Earl of Queen's and of several mycologists gives promise that this condition will be remedied in the future.

The initial impetus to the study of plant pathology came from the recognition of its value to agriculture, as was the case in plant breeding. One of the chief purposes of the founding of the experimental farms was the control of fungous diseases of plants, and in furtherance of this aim Saunders and Fletcher, who were both interested in plant pathology, laid the foundations of our Federal Pathological Service. In 1909 on the appointment of Güssow as Dominion Botanist, control of this work passed into his hands. Now there are ten well-staffed laboratories investigating regional and special crop problems, including forestry. The Dominion Rust Research Laboratory at Winnipeg, for which the pioneer work of Fraser at Saskatoon on cereal pathology paved the way, deserves particular mention. It illustrates best the fundamental nature of the attack being made on such problems. Craigie's results are not only important in explaining the origin of different strains of wheat rusts but are of broad scientific significance, while the breeding for rust resistance by Goulden illustrates the preventive method of modern plant pathology. The Federal system has been supplemented in several of the Provinces. Indeed the Ontario Agricultural College at Guelph came very early into prominence in this field, where, under the leadership of Howitt, organized work has been under way since 1898.

The need of adequately trained investigators in plant pathology has forced attention to their training on the Universities where facilities for advanced study in botanical and other fundamental work already existed. The University of Toronto has responded to a larger extent than any other at present, and the laboratories of the new botany building, which will be ready for students next session, contain a section specially equipped for pathological training and research. This phase of the work is in the competent hands of D. L. Bailey recently appointed to the staff of the Botany Department for this specific purpose. May I add that co-operation with the Ontario Agricultural College, Vineland Experiment Station and the Dominion Laboratory of Plant Pathology at St. Catharines ensures contact with problems of a practical nature.

Before concluding this survey of the last fifty years of botany in Canada, I should like to make reference to certain influences affecting the present and future development of botany as a whole. Aid for students in the form of scholarships, fellowships, etc. is a splendid thing and the institutions and private individuals making provision for them are to be highly commended. Equally valuable for the solution of research problems, and more so for quick and important results, would be some form of financial aid for the older men of proven

scientific ability, who are in charge of these students. Help in the form of technical assistance, travelling expense, apparatus, etc. would undoubtedly yield valuable results. This matter was broached at the Conference of Canadian Botanists held under the auspices of the National Research Council in 1929, when for the first time in the history of Canada botanists from all parts of the Dominion were brought together and given an opportunity to discuss their common problems and difficulties. That other future good will come from the conference, in which Dr. Tory showed his personal interest by presiding, there can be no reasonable doubt. One of the broad features discussed was the need for a Botanical Survey of Canada with its associated herbaria, and the co-operative effort necessary among Canadian botanists to attain this desirable end. In order to further this aim, and for the effective co-ordination of botanical effort in Canada, the necessity of organization is apparent. Already there are societies for technical agriculturists and for plant pathologists, which have proved their worth. Why not a Canadian Botanical Society, or a Botanical Section in a larger organization similar to the British or the American Association for the Advancement of Science—"A Canadian Association for the advancement of Science," perhaps affiliated with one or both of the sister organizations! I favour the latter because we need in Canada some organization which will foster the proper atmosphere of co-operation between business and scientific men, and this can be done more effectively by the larger organization, without impairing its scientific efficiency. A question that many of us have asked ourselves is whether the Royal Society of Canada could not advantageously be turned into such an organization, in which the younger scientific men as well as their elders would have an active interest.

In this brief sketch omissions have been unavoidable. For example. because of the extent and specialized character of the fields covered by bacteriology and forestry no reference was considered better than an inadequate one. Any omissions of personnel or of subject matter in the fields I have attempted to cover have been inadvertent and I hope will be condoned. Even this hasty sketch would have been impossible in the limited time allowed, had it not been for the valuable help I received from various botanists of Section V and for Dr. Kathleen Hull's invaluable assistance in assembling and collating the material. To each of them I extend my sincere thanks.

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